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Surgery & Pathology for L.D.S.

Inflammation Abscess Sinus & fistula.
Ulceration & repair
Effect of injury Shock traumatic fever
delirium.
Contusions Wounds burns & scalds.
Arteries How they heal when cut
Haemorrhage Aneurism.
Fractures dislocations
Injuries of head face chest & throat

Gangrene Erysipelas Pyaemia
Tumours Tubercle Syphilis Gonorrhoea
Rickets
Diseases of bone

Diseases of Jaw Head & Neck, mouth &
throat, Scalp, nose, polypus
post nasal growth. fistula

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SURGERY

ITS

THEORY AND PRACTICE

STUDENT'S GUIDE SERIES.

SURGERY

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THEORY AND PRACTICE

BY

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SURGEON TO THE METROPOLITAN HOSPITAL;
EXAMINER IN ANATOMY AND SURGERY TO THE SOCIETY OF APOTHECARIES

WITH 294 ILLUSTRATIONS

SECOND EDITION

LONDON
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PREFACE

TO THE SECOND EDITION.

Too short a time has elapsed since the publication of the first edition to render any material alteration in the second necessary. The book has, however, been thoroughly revised, and the liberality of the Publishers has enabled me to add eighty-four pages and fifty-eight new illustrations.

Sections on the Ear and Eye have been kindly contributed by my colleagues, Mr. Cumberbatch and Mr. Jessop respectively. They will, I hope, increase the usefulness of the work.

I have again to thank my friend Mr. W. G. Spencer, now Assistant-Surgeon to the Westminster Hospital, for many valuable suggestions, and for reading the proof-sheets.

The new illustrations were drawn by Mr. Leonard Mark, M.R.C.S., artist to St. Bartholomew's Hospital, either from specimens in the Hospital Museum, or from rough sketches of my own.

27, Weymouth Street, W.
April, 1889.

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PREFACE.

When asked by the Publishers to write a small book on Surgery for their Student's Guide Series I readily undertook the task, since as a teacher of Surgery I had for some time felt that a work of the kind would be useful to the student when first entering on the study of that subject. The text-books in general use have, with the advance of Surgery in recent years, grown to such a length that many months are required even to read them through, and it is quite impossible for the student to master them during the comparatively limited period allotted to dressing in the wards and out-patient room. The present work is designed to aid him in gaining a general insight into the theory and practice of Surgery while he is yet engaged in practical work in the wards; at a time, that is, when such a knowledge should be of especial value to him.

With this aim in view it was necessary to present the subject in as brief and concise a manner as possible; but whilst so doing I have endeavoured not to lose sight of the principles that underlie the science, and to give the indications that should guide us in the practice of the art rather than any detailed account of treatment.

Special prominence has been given to those subjects with which every student ought to be acquainted; whilst the rarer injuries and diseases have received but a brief mention, or have been altogether omitted.

The details of operative Surgery, and Minor Surgery and bandaging, and such other things as the student is taught practically to do for himself in the wards, have been only shortly discussed; and no account has been given of the specialties of the Eye and Ear.

It will be seen, therefore, that the book is in no way intended to take the place of any of the excellent Manuals of Surgery in present use, but rather to supplement them, and prepare the student the better to profit by their perusal at a subsequent stage in his studies. It is also hoped that it may serve to refresh his memory before presenting himself for examination in Surgery.

My best thanks are due to Mr. Spencer, late House-Surgeon to St. Bartholomew's Hospital, for his kindness in reading through the proof sheets, and to Mr. Godart, Artist to St. Bartholomew's Hospital, for his care in preparing and making drawings. I am also indebted to Messrs. Arnold and Son for the use of several woodcuts.

The space at my command did not permit of reference in the text to the authors consulted; but I here express my indebtedness for the aid I have received from the works of Agnew, Billroth, Bryant, Erichsen, Holmes, and Pirrie, and from the various articles in Holmes' "System of Surgery," Heath's "Dictionary of Surgery," and Treves' "Manual of Surgery."

27, Weymouth Street, W.,
July, 1887.

CONTENTS.

SECTION I.

GENERAL PATHOLOGY OF SURGICAL DISEASE.

PAGE
Inflammation 1
Chronic inflammation 16
Suppuration and abscess 17
Sinus and fistula 25
Ulceration and ulcers 26
Gangrene or mortification 34
Tubercle and tuberculosis 42
Struma or scrofula 45
Syphilis 47
Hæmophilia 59
Tumours 60
Cysts 85

SECTION II.

GENERAL PATHOLOGY OF INJURIES.

Wounds 90
Contusions or bruises 107
Burns and scalds 108
Hæmorrhage 111
Constitutional effects of injury 127
Diseases the result of septic and infective processes in wounds 132

SECTION III.

INJURIES OF SPECIAL TISSUES.

Injuries of bones 157
Injuries of joints 174

PAGE
Injuries of muscles and tendons 183
Injuries of arteries 185
Injuries of veins 193
Injuries of nerves 195

SECTION IV.

Diseases of Special Tissues.

Diseases of bone 200
Diseases of joints 231
Diseases of muscles 258
Diseases of tendons 259
Diseases of fasciæ 262
Diseases of bursæ 263
Diseases of arteries, including aneurism 264
Diseases of veins 303
Nævus 310
Diseases of lymphatics 312
Diseases of nerves 316
Surgical diseases of the skin 320

SECTION V.

Injuries of Regions.

Injuries of the head 328
Injuries of the face 353
Injuries of the neck, including the entrance of foreign bodies into the pharynx, œsophagus, and air-passages . 359
Injuries of the back 368
Injuries of the chest 374
Injuries of the abdomen 382
Injuries of the pelvis 392
Injuries of the upper extremity 402
Injuries of the lower extremity 432

SECTION VI.

DISEASES OF REGIONS.

PAGE
Diseases of the scalp and skull 466
Diseases of the brain, calling for surgical interference . 469
Diseases of the ear 469
Diseases of the eye 485
Diseases of the lips, cheeks, and mouth 514
Diseases of the tongue 523
Diseases of the uvula, palate, fauces, and tonsils . . . 533
Diseases of the gums and jaws 539
Diseases of the nose and naso-pharynx 548
Diseases of the pharynx and œsophagus 561
Diseases of the larynx 568
Diseases of the parotid gland 585
Diseases of the thyroid gland 586
Diseases of the spine 589
Surgical diseases of the intestines, including hernia . . 605
Diseases of the liver, gall-bladder, stomach, and spleen, calling for surgical interference 622
Diseases of the rectum 657
Diseases of the urinary organs 673
Diseases of the genital organs 741
Diseases of the female genital organs 766
Diseases of the breast 776
Deformities of the neck, knees, and feet 789

APPENDIX.

Amputations 801

INDEX 809

Pathology investigates the nature of disease
Physiology [illegible] of the [illegible]

ERRATUM.

Page 27, description of Fig. 3, *for* "raised cells" *read* "round cells."

[illegible]

SURGERY;

ITS

THEORY AND PRACTICE.

SECTION I.

GENERAL PATHOLOGY OF SURGICAL DISEASES.

INFLAMMATION.

INFLAMMATION is defined by Dr. Burdon Sanderson as "the succession of changes which occurs in a living tissue when it is injured, provided that the injury is not of such a degree as at once to destroy its structure and vitality." Inflammation as thus defined may occur in any tissue of the body, and you will do well to impress upon your mind at the outset, that in whatever tissue or organ it occurs, whether superficial or deep, transparent or opaque, vascular or non-vascular, soft or hard, the pathological process is essentially the same.

GENERAL OUTLINE OF THE PROCESS.—Let us first study the process as it may be observed by the naked eye, say, in a portion of inflamed skin. The part is uniformly red, hotter than the surrounding skin, swollen and painful. The redness momentarily disappears on pressure, and gradually fades away into the natural colour of the part around, but later it becomes mottled and in places of a deeper hue. There is usually some œdema about the inflamed spot, and the neighbouring lymphatic glands may be slightly tender and enlarged. If an incision were now made into the inflamed tissues, they would be found fuller of blood than natural, of a bright red colour, and infiltrated with serum; whilst if the lymphatics leading

∴ Systole contraction of auricle (inwards)
Diastole expansion of auricle & ventricle (outwards

from the part were opened, as has been done in animals, they would be seen to be transmitting more lymph than under normal conditions. The inflammation may now terminate, leaving the tissues apparently normal (*resolution*), or it may lead to certain changes producing irreparable damage to, or total destruction of the part. Thus the process may become chronic and the tissues thickened and indurated (*fibroid thickening*); or the tissues in the centre of the inflamed spot may soften and break down, forming a creamy fluid called pus (*suppuration and abscess*); or the more superficial tissues may undergo molecular destruction, leaving a raw surface (*ulceration*); whilst again the whole of the tissues in the inflamed area may lose their vitality and die "en masse" (*gangrene*). When the inflammatory process is at all severe, constitutional symptoms will also be present. Thus, the temperature will be more or less raised, the skin dry, the pulse increased in rapidity, the tongue furred, the appetite lost, the bowels confined, and the urine scanty and high-coloured — a condition known as *inflammatory fever*. Under some circumstances the constitutional symptoms may be of a more serious character, and secondary inflammations may be set up in internal organs or in other parts of the body: the patient is then said to be suffering from *septic* or from *infective poisoning*, conditions which, as will be pointed out hereafter, are probably due to poisonous products entering the general blood-stream at the primary seat of inflammation.

The *minute changes* which occur in the above-described phenomena have of late years been very accurately studied in such transparent parts as the mesentery of the frog, rabbit, and dog; and in sections of such structures as the cornea and lip. The following is a brief summary of what is observed. After, in some instances, a momentary contraction, the vessels become dilated, the arteries first and then the capillaries and veins, and the blood in them flows with greater rapidity (*determination of blood or active hyperæmia*), whilst smaller vessels which were previously invisible are now seen transmitting blood. Hence the redness of the part. Now, after a longer or shorter period, according to the kind of irritant used to set up the inflammation, the blood-current slackens at first in the veins and then in the capillaries and arteries, and leucocytes are seen to drop out here and there from the central stream or axial current, which appears yellowish in colour from the red corpuscles being contained in it. These truant leucocytes first roll lazily along in the pale or circumferential current, and are joined by more and more as the blood-stream further slackens in speed. Now they adhere to the walls of the veins, and to a less extent to the walls of the capillaries and arteries, so that the vessels appear as if lined with them. Soon they begin to pass through the vessel-walls into the tissues around (*diapedesis*), a process which need not here be described, as it is now fully treated of in works on Physiology. By and by, if the inflammation is very acute, the coloured corpuscles, in groups of two to a dozen, also leave the central stream and pass through the walls of the vessels into the tissues, producing those patches of darker redness and the mottling of the surface alluded to above. The central stream next begins to oscillate, flowing onwards during the systole, and slightly receding during the diastole of the heart; whilst the coloured corpuscles show a tendency to adhere to one another. Finally the stream stops, and *stasis* is said to have occurred (Fig. 1).

In the meantime the liquid contents of the vessels have also been passing through the vessel-walls into the tissues, and together with the escaped leucocytes, account for the swelling and for the *serous exudation* which can be squeezed out when the parts are cut into. The serum, further, soaks into the neighbouring healthy tissues, thus explaining the surrounding œdema, and is thence, along with some of the leucocytes, taken up by the lymphatics, and so passes back into the circulation, and as we shall presently see, may partly account for the attendant inflammatory fever. If now the cause of the inflammation ceases to act, and the vitality of the tissues has not been too much lowered to permit of their recovery, the corpuscles in the middle of the stream in those vessels where stasis has occurred again begin to oscillate and then to move on; the leucocytes no longer drop out of the axial current, and those that have already escaped into the tissues either break down or pass along with the escaped fluids into the lymphatics, leaving the part apparently uninjured (*resolution*).

If the above favourable termination does not take place and stasis is not soon relieved, coagulation of the serum rapidly ensues, and the vessels become thrombosed. At the same time, moreover, coagulation of the liquid exudation in the tissues also occurs, in consequence it is said

(clot)

of the fibrin-ferment contained in the leucocytes causing the (fibrinogen) in the liquid to unite with the (fibrinoplastin) in the leucocytes. The clot thus formed contracts, squeezing out the serum, which is then drained away by the lymphatics, so that if the parts at this stage be cut into, a serous exudation will no longer escape. The original tissues, partly in consequence of the plugging of the vessels, and partly in consequence of the digestive action of the leucocytes and soddening effect of the fluid exudation, become swollen and softened, and finally lose their vitality and disappear among the leucocytes, which then completely take their place, forming a mass of closely packed small cells embedded in a very slight amount of intercellular substance. Amongst these cells may now be seen numerous delicate capillary loops which have been derived from the capillaries around. To this vascularized tissue the name of *inflammatory new formation* or *granulation tissue* is given. Under favourable circumstances the cells themselves become gradually converted into fibrous tissue, producing the condition already referred to of *fibroid thickening* or *scarring*. Under less favourable circumstances the intercellular substance in the centre of

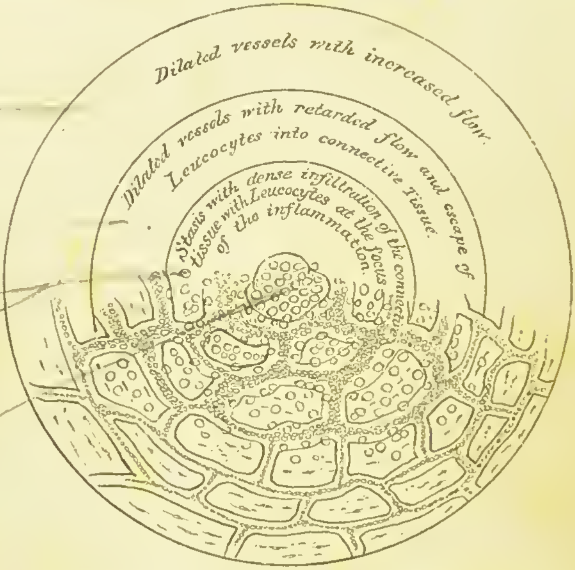

Dilated vessels with increased flow.
Dilated vessels with retarded flow and escape of Leucocytes into connective Tissue.
Stasis with dense infiltration of the connective tissue with Leucocytes at the focus of the inflammation.

FIG. 1.—Diagram of the minute changes in inflammation.

dilatation

exudation

cellular
[illegible]

ulcer
[illegible]

the mass of closely-packed cells liquefies; and the cells, cut off from their nutrient supply by the compression and thrombosis of the capillaries, undergo degeneration and die, and are then known as pus-cells, whilst the liquefied tissues and exuded serum form a fluid (*liquor puris*) in which they are contained. Thus pus is formed, and *suppuration* is said to be established. When these changes occur on the surface of the skin or mucous membrane, so that the products escape externally, the process, though essentially similar to that of suppuration, is spoken of as *ulceration*. And lastly, the infiltrated tissues in the centre of the inflamed area may lose their vitality and die *en masse*, before infiltration with leucocytes and serum has gone on sufficiently long to produce their softening; *mortification* or *gangrene* is then said to result.

Theory of the inflammatory process.—The theory most generally held at the present day is 1, that the inflammatory process is one of lowered vitality and not, as was formerly taught, one of increased nutritive activity; 2, that the irritant or exciting cause produces some molecular change in the vessel-walls, thereby rendering them capable of behaving towards the blood more or less like dead matter, and thus promoting a tendency to stasis and coagulation and the escape of leucocytes and serum in abnormal quantities; 3, that the inflammatory small-cell-exudation (*granulation tissue*), formerly regarded as a proliferation of the tissue elements, is derived from the accumulation of the escaped leucocytes in the tissues; and 4, that the tissue elements themselves remain passive or undergo degeneration.

Causes of inflammation.—The molecular change in the vessel-walls, which it is probable is the direct cause of the inflammatory phenomena, may be brought about by some influence acting upon them, 1, from within, through the blood; and 2, from without, either directly upon the vessel-walls themselves, or indirectly through the intervention of the contiguous tissues. Irritants acting in either of these ways may be looked upon as exciting causes, and would appear in some instances to be alone sufficient to set up the process. In other cases, however, certain prior conditions such as may be considered to lower the vitality of the tissues, and to render them less able to resist deleterious influences, appear necessary to render such irritants operative. Among such *predisposing* causes may be mentioned:—1. A deficient supply of healthy blood caused by insufficient or improper food and air, a feeble action of the heart, hæmorrhage, anæmia, and the like. 2. The presence of impurities or of certain poisons in the blood, such as exist in chronic alcoholism, Bright's disease, diabetes, gout, syphilis, and in lead, mercurial and phosphorous poisoning. 3. Deprivation of healthy nerve influence, as from disease or injury of a nerve centre, or nerve trunk. 4. Old age. 5. The strumous diathesis.

The *exciting causes*, which are usually spoken of as irritants, may be considered under the following heads:—1. Direct violence. 2. The chemical products of putrefaction. 3. Infective micro-organisms.

1. *Direct Violence.*—Under this head are included all forms of mechanical injury, excessive heat or cold, electrical stimulation, the application of strong acids or alkalies, or of irritating products, as croton oil or mustard. friction, and tension.

The above are regarded, as here, by the majority of Surgeons as exciting causes. By the extreme supporters of the germ theory, however, they are merely considered as predisposing causes, the exciting cause according to these pathologists being in every case micro-organisms. The character of this work will not permit of the discussion of the arguments for and against such a view, and it must here suffice to say that Dr. Burdon Sanderson, the highest authority on the subject in this country, has no doubt that inflammation can be induced by mechanical or other violence without the intervention of micro-organisms, although he admits that injuries which are in themselves inadequate to produce inflammation acquire that power when micro-organisms are present in the circulation.

2. *The chemical products of putrefaction* would appear to play an important part in the causation of inflammation, and are probably the chief agents at work in the production of spreading suppurative inflammation when it occurs in wounds. For fermentation or putrefaction (or sepsis as it is often called) to occur, there must be dead animal matter, a sufficiency of water and oxygen, the maintenance of a certain temperature, and the presence of a ferment. This ferment, according to the germ theorists, consists of living microscopic organisms, called bacteria, which exist in large numbers in the air, water, &c., in short everywhere, except in mid-ocean and above

the snow line on mountains, and are especially numerous in large cities, hospitals, &c. It is not thought, however, that the inflammation is lighted up by the bacteria themselves, but by the chemical products (*sepsin*, *ptomaines*) which are formed in the process of putrefaction, and which soak into the surrounding tissues, acting like any irritant fluid. For it has been found that when a fluid swarming with bacteria is injected into the blood or connective tissue of a living animal, the bacteria rapidly disappear without causing inflammation or other ill effect. Again, if a similar fluid is injected into the peritoneal cavity in such quantities only as to allow of its rapid absorption, no inflammation ensues. On the other hand, if such a fluid, or even water, is injected in quantities more than can be rapidly absorbed, serum from the blood is effused into it; and as all the essentials for putrefaction are now present, viz., diluted serum which constitutes the dead animal matter, heat, moisture, oxygen, and bacteria to act as a ferment, putrefaction ensues, and inflammation results. From these and similar experiments it is inferred that the bacteria themselves are incapable of setting up inflammation; that they are only able to thrive in dead animal matter, and not in living tissues; and that it is the products of putrefaction, of which they are believed to be the cause, that set up the inflammatory process.

3. *Infective micro-organisms.*—These, which include the various species of micro-organisms, known as the bacillus and micrococcus, are also believed to play an important *rôle* in the causation of inflammation. Indeed, they are believed by some pathologists to be the essential factors in all inflammatory processes. But whilst it cannot be admitted that they are the exciting cause of all inflammation, the belief is fast gaining ground that they are important, if not the chief agents in many inflammations, and especially in those inflammations which, because they occur without any apparent cause, were formerly spoken of as *idiopathic*. Thus erysipelas and some forms of periostitis appear to depend upon them, whilst malignant pustule has been proved to do so. Unlike bacteria, the organisms which are found in all decomposing fluids, and which as we have seen are unable to exist in the living tissues, many species of bacilli and micrococci are not only capable of living in such tissues, but thrive and multiply in them, and whilst doing so give rise to certain irritating products which set up inflammation. Hence they are

Bacteria unable to exist [illegible]
Bacilli & M.C. capable of living [illegible]

called *infective*, *parasitic*, or *pathogenic* fungi. They are supposed not only to multiply and spread in the surrounding tissues, setting up inflammation in their course, but also to enter the system by the blood and lymph vessels, where, still multiplying, they poison the body generally, and in consequence of their becoming lodged in various tissues or organs of the body where they further multiply and thrive, to set up a like inflammation. The way in which they enter the body is either by a wound direct, or else by the alimentary or respiratory mucous tract. Where they enter by a wound, it appears that decomposition of the discharge favours their entrance (as in erysipelas occurring in a septic wound), though such is not essential. They or their spores are supposed to exist in the air, water, &c., but in less quantities than the bacteria, and only occasionally, as, for instance, when a case of specific inflammation to which they are supposed to give rise is present in the same ward.

Bacterium termo

As bacteria, bacilli, and micrococci will have to be frequently mentioned, they may be here briefly described. The common form of bacterium (*bacterium termo*) is a rod-like body about $\frac{1}{25000}$ of an inch in breadth, and less than twice its breadth in length. It multiplies by fission, not by spores. It is easily killed by antiseptics, and will not thrive in living tissues; hence it is named *nonpathogenic*, and, as it is always found in putrefying or septic fluids, is also spoken of as the *carrion* or *septic* fungus.

The bacillus is also a rod-like body, but it is more than twice its breadth in length. It multiplies by spores as well as by fission. Its spores resist heat and cold, chemical re-agents, drying and strong solutions of carbolic acid, but are killed by bichloride of mercury and permanganate of potash. The bacilli of surgical interest are the anthrax bacillus, the cause of malignant pustule, the tubercle bacillus found in tubercular disease, and the bacillus of glanders, of leprosy, of syphilis, and of tetanus.

The micrococcus is a round or oval body, from $\frac{1}{10000}$ to $\frac{1}{25000}$ of an inch in diameter. It occurs singly or in pairs, sometimes in chains or in colonies known as zooglœa masses, and multiplies by fission. Micrococci, though often found in putrefying fluids are, like the bacilli, not thought to cause putrefaction. Among the pathogenic species may be mentioned those found in acute abscesses, boils, erysipelas, gonorrhœa, acute periostitis and osteomyelitis, septicæmia, and pyæmia.

Bacillus Leprae

SIGNS AND SYMPTOMS of inflammation. These may be divided into the local and the constitutional. The *local* signs are the well-known redness, heat, pain, and swelling, to which may be added disturbance or alteration of function. Except in a typical case, these signs are not all necessarily present; on the other hand the presence of one or more is not always indicative of inflammation.

The *redness* is due to the dilatation of the small arterioles, veins and capillaries, and increased flow of blood to the part; the darker patches over the general surface to the escape of red corpuscles, and to the blood passing into the veins before the oxyhæmoglobin has all been reduced. The redness varies according to the intensity of the inflammation, being bright in the acute, and dull in the chronic variety, and generally assumes a livid hue when suppuration is about to occur. It may sometimes be absent as in inflammation of non-vascular tissues, although present in the vascular area around. It more or less disappears after death.

The increased *heat* is now generally held to be due merely to a greater flow of blood through the part, and not to any generation of heat in the part itself, as the blood coming from it is never hotter than the blood in the left ventricle of the heart. The inflamed part, however, feels intensely hot and burning to the patient, although the thermometer shows little actual increase of heat.

The *pain*, which is due to pressure upon or stretching of the terminal nerve-twigs by the dilated blood-vessels and by the exudation, varies in intensity and character, and is nearly always increased by pressure and by the dependent position. It is of a stabbing character in serous membranes, aching in bone, throbbing when pus is about to form, more intense when occurring in organs where but slight stretching can occur, as the globe of the eye or the testicle, and less intense in parts like the axilla where the tissues are loose. In the eye, as well as pain, there may be flashes of light; in the ear, noise. The pain is sometimes referred through the nerves to other parts or organs.

The *swelling*, which is caused partly by the increased quantity of blood in the inflamed area, and partly by the exudation of leucocytes and serum, is, as might be expected, greatest in lax tissue, as the axilla, and least in the dense and fibrous, as bone or tendon. It is always an important sign in chronic inflammation where there may be but little redness or pain.

The *disturbance in function*, which practically always occurs in an inflamed part, may be illustrated by the inability of an inflamed bladder to retain urine, or of an inflamed eye to tolerate light.

The *constitutional symptoms* may be summed up as those of fever. There is a rise of temperature—often preceded by chilliness or even a distinct rigor, a quickened pulse, dry skin, furred tongue, loss of appetite, constipation, scanty and high-coloured urine, headache, perhaps delirium, and a general feeling of malaise. When the inflammation is slight there may be no fever; but when it is at all intense, or occurs in an important part, it is generally considerable, and in septic and infective inflammations is by far the most anxious symptom. Inflammatory fever has been divided into the sthenic, asthenic, and the irritative or nervous. In the *sthenic* the symptoms are acute, the temperature is high (104° or 105°), and the pulse full, strong and bounding. In the *asthenic* the symptoms assume what is called a typhoid character; the temperature falls, the tongue becomes brown and dry, the lips and teeth are covered with sordes, and the pulse is quick, soft and feeble. In the *irritative* there is in addition to either of the above set of symptoms delirium, violent in the one case, or low and muttering in the other, and a general nervous state.

The *cause* of the fever has been variously explained. In simple inflammation it may be due: 1, in part to tissue-change caused by the presence in the blood of free fibrin ferment (a substance known to possess pyrogenic or fever-producing properties), which is supposed to be derived from the escaped leucocytes and drained away in the serum from the inflamed part by the lymphatics; and, 2, in part to disturbance of the heat-regulating centre in the medulla oblongata, induced either reflexly, through the sensory nerves, as when there is much pain and tension in the inflamed part, or directly, by the action on it of the deteriorated blood. In septic inflammations the absorption of the products of fermentation or putrefaction, as from a septic or ill-drained wound, has no doubt a large share in the production of the fever, which is then spoken of as septic (*septic fever, sapræmia*); whilst in the infective inflammations the presence of micro-organisms is believed to be chiefly concerned (see *Septicæmia* and *Pyæmia*).

Varieties of inflammation.—Inflammation may be divided into the *acute* and *chronic* according to its intensity and duration; the acute again into the *simple*, the *septic*, and the *infective*. What has already been said applies chiefly to the acute variety. The chronic is discussed separately later on.

Simple inflammation is that which remains localized to a limited area, and subsides usually without suppuration as soon as the cause is removed. It is commonly the result of a mechanical injury, and may be studied in its simplest form in the healing of an incised wound by the first intention (see *Wounds*).

Septic or *spreading* inflammation depends upon the presence of putrefaction in a wound; it spreads beyond the original seat of injury, is accompanied by suppuration, and frequently by constitutional symptoms of blood-poisoning (*septic fever, sapræmia*). The spreading is due to the products of putrefaction soaking into the tissues, where they act like other chemical irritants, and so set up wider and wider circles of inflammation; but they do not multiply in the living tissues, like the micro-organisms producing the infective inflammation to be next described, but are merely formed by the putrefaction of the inflammatory products (*serum, pus, sloughs*). Hence as soon as putrefaction can be checked the spreading of the inflammation has a tendency to cease. The accompanying fever is due to the chemical products being drained away in the serum by the lymphatics, and so entering the general blood stream (see *Septic processes in wounds*).

The *infective* variety is also of a spreading character, and is believed to depend upon the presence of a specific micro-organism (*bacillus* or *micrococcus*). Unlike the products of putrefaction these micro-organisms multiply and thrive in the living tissues and in the blood stream. They may also under certain circumstances become lodged in the lymphatic glands and in the capillaries of distant organs or tissues, where they give rise to inflammations similar to that at the seat of primary inoculation. Like the septic, the infective inflammations are generally accompanied by severe constitutional symptoms. The micro-organisms may enter, it is thought, either through a wound, or through the respiratory or alimentary tracts; and, though not essential, a septic wound favours their admission. (See *Infective processes in wounds.*)

Inflammation also admits of other divisions; thus it is variously spoken of as traumatic, idiopathic, strumous, syphilitic, gouty, &c., according to its supposed cause; as adhesive, suppurative, and ulcerative, according to its termination, &c.

The *treatment* of inflammation may be divided into the *Preventive* and the *Curative*. The former will be discussed under the *Treatment of wounds*.

Curative treatment.—This must necessarily vary according to the character and situation of the inflammation and the type of constitutional disturbance. Here only are given the indications which should guide us in the general management of the case. Our *first* endeavour where practicable should be to remove the cause. Thus a foreign body in the tissues, such as a thorn in the finger, should be extracted; tension should be relieved; a free drain established for any pent up and decomposing discharges; exit given to extravasated secretions, as putrid urine and the like; irritating applications, as strong antiseptics, exchanged for less irritating dressings; and such constitutional causes as syphilis, gout, &c., treated by appropriate remedies. When the cause can be thus removed and fresh sources of irritation avoided, the inflammation will tend of itself to cease. Where such cannot be done, we should endeavour in the *second* place to prevent the complete loss of vitality of the already injured tissues and to restore their healthy nutrition. For this purpose our efforts should be principally directed to controlling the supply of blood to the part, and reducing the blood pressure in the damaged blood-vessels in order to lessen the escape of leucocytes and serum, the pressure of which in the vessels and tissues leads to the death of the part, whilst the tension to which they give rise is a fertile source of fresh irritation and consequently of the continuance of the inflammation. Further, we should aim at counteracting this injurious pressure and tension by facilitating the draining away of the products of inflammation; whilst we should seek to promote the return of healthy nutrition to the inflamed tissues by endeavouring to remedy such constitutional defects, which, as we have seen, by lowering their vitality act as predisposing causes. *Thirdly*, we should not lose sight of the important indication to relieve pain. And *lastly*, whilst directing our efforts to the treatment of the local inflammation, we must modify our remedies according to the type of constitutional disturbance to which it may give rise.

General remedies.—The means at our disposal for fulfilling the above indications are both local and constitutional. In some cases local remedies alone will suffice, in others constitutional remedies will also be required.

The local may be enumerated as rest, elevation of the part, cold, heat and moisture, local blood-letting, incisions, and astringents. These means should not be used indiscriminately; those that may at one period be of the greatest benefit, may at another produce the result we are trying to avoid.

Rest is one of the most important means we possess in the treatment of surgical inflammation. It should be complete, and as far as possible both physiological and functional. Thus, an inflamed joint should be placed on a splint, an inflamed eye receive no light, &c.

Elevation of the part relieves swelling and tension by diminishing the arterial supply, and promoting venous return, and the draining off by the lymphatics of the inflammatory exudation. Thus, an inflamed hand should be placed in a sling, an inflamed foot on a pillow, &c.

Cold, though a most powerful agent in controlling inflammation, is one that requires cautious and seasonable application. It acts by causing contraction of the small arteries, and consequently diminishes the supply of blood to the part; it likewise controls the amœboid action of the leucocytes. At the same time when intense it lowers the vitality of the tissues and promotes adhesion of the corpuscles and stasis, and as exemplified by frost-bite may destroy the part. It is of the most service in the preventive treatment of inflammation, and for controlling the process in the early stages. Later, when the inflammation is fully established, it can only do mischief. Its action should be continuous; if applied intermittently it tends to increase the inflammation by the reaction which follows each application. It is best applied in the form of an ice-bag, or by irrigation with ice-cold water, or by Leiter's tubes.

Heat and moisture act by causing a general dilatation of the capillaries and free flow of blood through the part. They are especially useful when the inflammation has become fully established, and suppuration is threatened. Under the latter circumstances they tend to localize the process, and bring the abscess to the surface. They may be applied in the form of a linseed-meal poultice or hot fomentations to which opium and belladonna in some form may be added to soothe and relieve pain. Heat alone may be applied by means of Leiter's tubes, the water being kept heated by Krohne's lamp.

Local blood-letting relieves the vessels of the inflamed part, and so removes tension. It may be employed in the form of leeches, wet-cupping, or incisions with a lancet. It is often of great benefit, even when not applied directly over the part, as is shown by the relief afforded to an inflamed eye by a leech behind the ear.

Incisions are useful in some forms of inflammation, as phlegmonous erysipelas, to relieve tension. They should be made in the long axis of the limb, taking care to avoid important structures.

Pressure on the main vessel, or even ligature, has lately been resorted to in Italy, and apparently with some success.

Astringents act by constricting the blood-vessels, and are especially useful in inflammations of the mucous membrane of the mouth, nose, urethra, conjunctiva, &c.

Constitutional remedies, like the local, should be used according to the intensity, nature and situation of the inflammation, and the type of the constitutional disturbance. In an ordinary case of simple inflammation, beyond a brisk purge, subsequent regulation of the bowels and secretions by salines, and restricting the diet, no special constitutional treatment is required. But when the fever is high, the patient young and vigorous, and the pulse rapid, full, and strong—in short, where the fever is of the sthenic type, antiphlogistic or lowering treatment should be adopted. Where, on the other hand, the patient is weakly or old, or broken down in constitution, and the fever is of a low or asthenic type, a stimulating plan of treatment will be required.

Antiphlogistic treatment may be considered under the heads of diet, drugs, and general blood-letting.

The *diet* should be restricted to milk, weak beef-tea, barley-water, arrowroot, and the like.

Drugs.—Purgatives determine the flow of blood to the intestines, and so relieve the inflamed part. They are not, however, generally employed except as a brisk purge at the onset of the inflammation, and in gonorrhœa and orchitis, in which they are of considerable benefit. In inflammations of the intestine and peritoneum they should not as a rule be used at all. Diaphoretics and diuretics relieve the distended vessels, the former by determining the flow of blood to the skin, the latter to the kidneys. They are not often employed in surgical inflammations. Aconite in small doses frequently repeated is believed to reduce the frequency and force of the heart's action, and is much praised by some. Antimony was formerly much employed, and is still used in inflamed testicle. Mercury in combination with opium was once in much favour, and was thought to have a controlling action on the inflammation. It is seldom given at the present day, except in syphilitic inflammation and as a purgative at the commencement of other inflammations. Opium, however, is frequently used to relieve pain, and it also seems to have some action in controlling the inflammation. It may be given by the mouth, or in the form of morphia as a subcutaneous injection. Quinine, salicylic acid and antipyrin are sometimes employed when the temperature is high, as is colchicum in gout, potash in rheumatism, perchloride of iron in erysipelas, and hyoscyamus and chloral when there is want of sleep.

Bleeding is not often employed in modern surgery, but it is at times beneficial in very acute inflammations in young and plethoric subjects. During twenty years' experience of hospital work I have seldom seen it used, although formerly it was in constant vogue. The blood may be taken from one of the veins of the arm, or from an artery, as the temporal.

The *stimulating plan* of treatment may be considered under the head of diet, drugs, and stimulants. The *diet* should consist of essence of beef, milk, eggs, milk-puddings, oysters, turtle soup, and of white fish and minced chops if solid food can be retained. Of *drugs*, ammonia and bark, or quinine and iron will generally be found of most service; whilst *stimulants* in the form of brandy, the brandy-and-egg mixture, port wine, champagne, or any other that the patient has been accustomed to take, should be given in divided and measured doses at stated intervals. Stimulants increase the force of the heart's action, and so drive the blood through the inflamed part, and maintain the circulation till the crisis has been tided over. The indications for their use are a feeble and frequent pulse, a high temperature, a dry and brown tongue, and general signs of prostration.

CHRONIC INFLAMMATION.

The pathological process in chronic inflammation is essentially the same as in the acute; but the dilated vessels appear to lose their tone, and remain dilated for longer periods, and the escape of leucocytes is continuous. Further it appears possible that the inflammatory exudation, which contains less fibrin-forming material and albumen, is formed in part by the original tissue cells as well as by escaped leucocytes. Like the acute it may terminate in resolution, suppuration or ulceration, but it is much more liable to produce chronic thickening, from the accumulation of the cellular elements in the tissues. It may also terminate in caseation or even calcification.

The causes of chronic inflammation are similar to those of the acute, but they appear to act with less intensity and for longer periods. Amongst the predisposing causes must be especially mentioned passive congestion, struma, rheumatism, gout and syphilis. The exciting causes are often very slight, and may be altogether overlooked; whilst secondary causes which may keep up the inflammation for an almost indefinite time frequently come into play. Thus in chronic joint-disease, though the cause may be but a trivial injury in a rheumatic subject, continual movement and tension due to the distension of the synovial membrane may keep up the inflammation for months or years. The presence of miliary tubercle is a frequent exciting cause.

Symptoms.—These are also local and constitutional. Of the local signs the redness may be absent, or, if present, of a dusky hue; whilst the part is often discoloured from pigmentation due to the disintegration of the coloured corpuscles. The pain is less severe than in the acute, often of a dull aching character and increased on pressure and sometimes worse at night. The part may be slightly hotter than natural, but at times no increased heat is apparent. The swelling is always a marked sign. Constitutional symptoms may be altogether absent; generally, however, the patient's health is feeble or below par, or he is strumous, or he has gouty, rheumatic, or syphilitic symptoms. At times there may be some fever when an important organ is affected.

Treatment.—The indications are:—to remove the cause and all secondary sources of irritation; to promote the

"[illegible]

absorption of the inflammatory products; and to re-establish the normal nutrition of the damaged tissues. For this purpose constitutional as well as local means should be employed. Thus:—we should endeavour to improve the general health by a careful dietary and the regulation of the secretions; whilst stimulants and tonics should be given where indicated." In the strumous, cod-liver oil, in the syphilitic, mercury or iodide of potassium, in the gouty, colchicum, and in the rheumatic, the salts of potash or guaiacum, are especially indicated; whilst residence at the sea, or at some spa suitable to the diathesis, or a sea voyage should be enjoined. Locally, the means at our command, besides rest of the part, are: 1, *counter-irritation* by blisters, tincture of iodine, and stimulating liniments; 2, *friction* with mercurial ointment, the oleate of mercury or ointments of iodide of lead or cadmium, or by shampooing, massage, etc.; 3, *pressure* by means of carefully applied bandages, Scott's dressing, or Martin's bandage, or the ammoniacum and mercury plaster; 4, the formation of *setons or issues*; and 5, the application of the *actual cautery*. Where suppuration threatens, as in chronic inflammation of lymphatic glands, sulphide of calcium may be of service in promoting the rapid breaking down of the caseating mass. It should be given in doses of $\frac{1}{6}$ to $\frac{1}{3}$ of a grain.

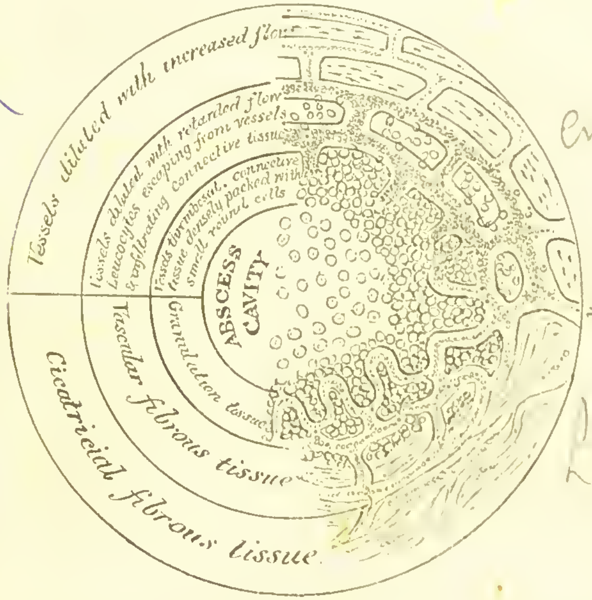
SUPPURATION AND ABSCESS.

We have already seen that under some circumstances the inflammatory process may terminate in the softening and breaking down of the inflamed tissues, death of the infiltrating leucocytes, and formation of pus, suppuration being then said to be established. This process, whether it occur 1, in the substance of the tissues or organs, or 2, on the free surface of the skin, a mucous or a serous membrane, is practically the same. In the former situation, it is spoken of as circumscribed, or as diffuse suppuration, according as it is limited in extent or the reverse; in the latter situation it is known as purulent exudation or catarrh, or as ulceration, according as the process merely involves the superficial layers of the epithelium, or extends through to the deeper parts. We will first deal with the circumscribed variety of suppuration or *abscess*, as this is the most familiar example to surgeons.

abscess – [illegible]

CIRCUMSCRIBED SUPPURATION OR ABSCESS. An abscess may be defined as a circumscribed collection of pus, the result of inflammation. It may be acute or chronic.

Acute Abscess.—The formation of an abscess may perhaps best be studied as it occurs in the superficial tissues. We have already seen that an inflamed part is hot, red, swollen, and painful. If the inflammation ends in suppuration, the swelling which was more or less diffuse becomes circumscribed and pronounced, the redness localized and more intense, the pain assumes a throbbing character, and a distinct chill or rigor is generally experienced. On pressing lightly with the fingers on the inflamed part a sensation of fluid beneath the skin is felt, and *fluctuation* is said to be present. If left to nature the abscess makes its way in the direction of least resistance, *i.e.*, generally towards the free surface of the skin, or if more deeply seated, towards a mucous canal, serous cavity, or the interior of a joint. Continuing to take a superficial abscess as our example, one part of the inflamed area becomes more prominent than the rest, and the skin over it red and glazed. The abscess is said to *point.* The skin will shortly ulcerate or slough, and bursting of the abscess with discharge of the pus will ensue. On the evacuation of the pus either naturally as above, or through an incision artificially made, the walls fall more or less together, and the cavity is gradually filled up by granulations till finally only a scar remains. The *minute changes* concerned in this process are briefly as follows:—The leucocytes which have escaped from the vessels in the way already described aggregate at the focus of inflammation; the tissues, in part from the pressure of the leucocytes, in part from the original injury, and in part from lack of nourishment consequent on the thrombosis of the vessels, undergo softening and liquefaction, and finally disappear among the leucocytes which now completely replace them in the form of a mass of small round cells (granulation-tissue). The cells in the centre of this dense mass being also cut off from their nutrient supply by the destruction of the vessels, in their turn degenerate and die, and are now found floating in a fluid formed by the liquefied tissues and serous exudation infiltrating the part. The dead leucocytes are known as *pus-corpuscles*, the fluid as *liquor puris.* Thus a cavity is formed containing pus and surrounded by a layer of vascular granulation-tissue (*the pyogenic zone*). The accompanying woodcut (fig. 2) illustrates diagrammatically the appearance that would be presented by a section through an abscess and the surrounding tissues. In the centre is the abscess cavity; around this in the upper half of the diagram are zones representing the inflammatory changes in various stages of progress. When an abscess enlarges it is simply by


Vessels dilated with increased flow
Vessels dilated with retarded flow
Leucocytes escaping from vessels
& infiltrating connective tissue
Vessels thrombosed, connective tissue densely packed with small round cells
ABSCESS CAVITY
Granulation tissue
Vascular fibrous tissue
Cicatricial fibrous tissue

Enlarging

healing

FIG. 2.—Diagrammatic representation of the minute changes in the formation and healing of an abscess. The upper half shows abscess enlarging; the lower half abscess healing.

the extension of the inflammatory process from zone to zone. The central cavity increases by the successive degeneration of the small round cells, which fall into the cavity and become pus-corpuscles, whilst what was formerly the zone of thrombosis is now converted by the aggregation of the leucocytes into the zone of small round cells, the zone of dilated vessels and retarded flow into the zone of thrombosis, and so on to the circumference. Such at least occurs when an abscess spreads uniformly in all directions. Usually, however, it makes its way in the direction of least resistance, these changes then occurring chiefly at that part. If an abscess is not opened the tension and the presence of the pus keep up the inflammation, but when the pus is evacuated and all sources of irritation are removed the circulation in the vessels around resumes its normal state. The walls in consequence of the pressure of the surrounding tissues fall more or less into contact, and what remains of the cavity is gradually filled up by the growth of the granulation-tissue. The granulation-tissue is developed into fibrous tissue, which in its turn contracts, obliterating the blood-vessels, and is converted into dense cicatricial tissue. In the lower half of the diagram (fig. 2) are zones representing the various changes in the process of healing.

Characters of pus.—Pus from an acute abscess in an otherwise healthy person is called *healthy* or *laudable.* It is a thick, creamy, opaque, yellowish-white, slightly alkaline fluid, with a faintish smell, saltish taste, and a specific gravity of about 1030. If a drop is examined under the microscope it is found to consist of a fluid (the liquor puris) and corpuscles (pus-cells). The greater number of these corpuscles are globular, slightly granular, measure $\frac{1}{2400}$ of an inch in diameter, and contain two or three nuclei which are made more evident on the addition of acetic acid to clear up the granular matter. Amongst them may be seen other corpuscles indistinguishable from leucocytes, and exhibiting when examined on a warm stage amœboid movements. The latter are probably living leucocytes which have escaped into the abscess cavity, the former leucocytes which have undergone degeneration and death. The liquor puris consists of water, albumen, and salts, of which chloride of sodium is the chief. It coagulates on boiling. Though probably derived in chief part from the exudation of the serum through the vessels, it differs from serum in that it does not coagulate spontaneously. In acute abscesses the pus contains granular material derived from the rapid degeneration of the tissues, and various species of micrococci. If allowed to stand or to decompose in an imperfectly drained abscess-cavity, it will be found moreover teeming with the bacteria of putrefaction.

Varieties of pus.—Pus is variously spoken of as *sanious* when it contains blood, *curdy* when portions of coagulated fibrin are seen floating in it, *ichorous* when of a watery consistency, *muco-pus* when mixed with mucus, and *infective* when containing micro-organisms. In some instances it has been observed to have a bluish-green colour (blue pus), which is supposed to be due to the presence of the micrococcus cyaneus.

The *Causes* of an acute abscess may broadly be said to be those of acute inflammation, and need not again be referred to. The circumstances, however, which cause the inflammatory process to terminate in suppuration may briefly be said to be the presence of micro-organisms and the persistent and long-continued action of an irritant, whereby is induced such a lowering of the vitality of the tissues and amount of injury (short of their actual destruction and consequent gangrene) that stasis and coagulation of the blood in the vessels ensue, and hence preclude the possibility of resolution occurring.

The *Symptoms* of an acute abscess are at first those of inflammation, followed, whilst pus is forming, by a chill or rigor and by throbbing pain in the part. The pain, however, usually ceases when suppuration is fully established. The local signs, when the abscess is superficial, are pointing, central softening, and when about to burst, a red and glazed appearance of the skin with separation of the cuticle. Deep suppuration is often difficult to detect; deep-seated fluctuation, œdema, sub-cuticular mottling and tenderness on pressure are then the chief signs; but puncture with a grooved needle will clear up any doubt.

Treatment.—The chief indications are to remove the pus with as little injury to the tissues as possible, to ensure a sufficient drain, and to maintain the parts aseptic. When it is evident that suppuration must ensue it should be promoted by moist warmth in the form of a large linseed-meal or boracic poultice sprinkled with opium, or hot poppy fomentations. As soon as fluctuation is detected the abscess should be opened by making a free incision in the most dependent part or where it is pointing, of course taking care to avoid blood-vessels or other important structures in the neighbourhood. The pus should generally be allowed to flow out of its own accord. To ensure a thorough drain, and to prevent any tension from re-accumulation, the opening should be free and a drainage tube should bo inserted. If the drainage is efficient, no harm will ensue if a poultice, the favourite treatment, be applied. But if the abscess is deep and the aperture small and there is thus danger of the pus becoming retained and undergoing decomposition, antiseptic dressings should be used, as under these circumstances the retained discharge will probably be under some degree of tension and the granulation-walls of the abscess hence inefficient to prevent absorption. Although it is a rule in Surgery to open an abscess as soon as fluctuation clearly shows that pus has formed, there are some instances in which this is especially imperative. Thus an abscess should be opened early when it is situated in the perineum, the abdominal or thoracic walls, the sheath of a tendon, under deep fasciæ or the peritoneum, in the orbit, near a joint, and in the neck if attended by dyspnœa; when obstructing some passage; when caused by the infiltration of urine, fæces, &c.; and when a spontaneous opening would produce deformity.

Hilton's method, as it is called, of opening an abscess, is very useful when the abscess is situated deeply and amongst important structures, as at the root of the neck or in the axilla. It consists in making an incision through the skin and fascia, and then working gently in the direction of the pus with a director. As soon as pus presents, a pair of dressing forceps is slid along the groove of the director into the abscess cavity, the director removed, and the blades of the forceps separated so as to stretch the opening and make a free exit for the pus.

The Complications of acute abscess are: 1. Hæmorrhage from the involvement of a large vessel. 2. The implication of some important part, as the peritoneal cavity, the interior of a joint, &c. 3. Degeneration into a sinus or fistula. 4. Blood-poisoning (*sapræmia*, *pyæmia*).

CHRONIC ABSCESS.—The process by which a chronic abscess is formed is similar to that described under the acute variety. The preceding inflammation, however, is of a chronic character, and the pus is formed slowly, and when deeply seated often without any symptoms of inflammation. A chronic abscess has a tendency to burrow in the tissues, especially in the long axis of the body; and its walls often become condensed and thickened, and lined with a layer of smooth granulations, which give it a velvety and mucous membrane-like appearance. The pus may be like that from an acute abscess, but is frequently thin and curdy. Micrococci and the tubercle bacillus are sometimes found in it. It never contains bacteria before the abscess is opened. *Cause.*—A chronic abscess is generally formed in connection with dead bone, joint-disease, a caseating lymphatic gland, or tubercular deposit. At times no cause can be discovered. *The symptoms* are very various, and differ according as the abscess is found in connection with dead bone, a diseased spine, &c., and will be again referred to under the head of suppuration in bone, psoas abscess, &c. Here it may be stated generally that the chief signs are a fluctuating swelling, often unattended with any sign of inflammation, and tho presence of some affection, as spinal caries, that is known to be often associated with abscess. Before a chronic abscess is opened there are usually no constitutional symptoms; but subsequently hectic fever or lardaceous disease of the viscera is very liable to ensue and terminate fatally from exhaustion, renal disease, diarrhœa, or hepatic mischief. *Diagnosis.*—A chronic abscess may be mistaken for a fatty tumour, a hydatid or other cyst, a blood-extravasation, or a soft solid tumour, and it may be quite impossible to arrive at a correct diagnosis without puncture with a grooved needle. The diagnostic points between theso affections will be further alluded to in the section on diseases of regions. *Terminations.*—A chronic abscess, after remaining quiescent for a long period, may take on increased action, and burst either externally, or into a mucous canal, a serous cavity, &c.; or the watery portions of the pus may be absorbed, leaving behind a caseous mass, which may either dry up or undergo calcification; or it may remain in its caseous state for years, and then break down, and set up fresh inflammation around, and produce what is called a *residual abscess*. *Treatment.*—Small chronic abscesses unconnected with diseased bone, joints, &c., may be treated like other abscesses by free incision, drainage, and prevention of putrefaction. Large abscesses, especially when the result of spinal disease, require very careful management. If free drainage and antiseptic precautions are neglected, and the pus is allowed to undergo putrefaction, long-continued suppuration and attending hectic generally follow and frequently terminate fatally. Hence, many advise that the opening of a chronic abscess should be delayed as long as possible—*i.e.*, until it is evident from the reddening of the skin, and its near approach to the surface, that it will, if left longer, burst spontaneously. The objections to this plan are, that the evil day is only postponed, and that in the meantime extensive destruction of the tissues is taking place as the abscess is allowed to enlarge. The best plan would appear to be to aspirate the abscess frequently so as to reduce its size, and then to open it freely with antiseptic precautions, and ensure thorough drainage subsequently. Aspiration alone, however, will in some cases suffice, the abscess drying up, and in this way becoming cured. When the abscess is lined with a thick layer of caseous pus, healing will be promoted by well rubbing the walls with a strong solution of chloride of zinc. The unhealthy granulations in tuberculous abscesses may be scraped away with a Volkmann's spoon.

DIFFUSE SUPPURATION may occur either, 1, in the substance of the tissues or organs; or 2, on the surface of the skin or a mucous or serous membrane. As examples of the former may be cited cellular, and cellulo-cutaneous erysipelas, in which, as the result of a spreading infective inflammation, extensive suppuration occurs through large tracts of the subcutaneous tissue; as examples of the latter, gonorrhœa, bronchitis, and some forms of peritonitis. The pathological process in both is practically similar, only that in one the inflammatory products (pus) are diffused through the tissues, and in the other, over the free surface. Suppuration on the free surface of the skin or mucous membrane when the deeper layers of these structures are involved, is, however, spoken of generally as ulceration; and when the epithelial layers only are affected, as intertrigo in the case of the skin, and as purulent catarrh in the case of a mucous membrane.

Constitutional effects of long-continued suppuration. Hectic fever and Lardaceous disease.—HECTIC FEVER is a common accompaniment of prolonged suppuration from whatever cause when the wound cannot be kept aseptic and efficiently drained. It has been ascribed to the drain on the system owing to the formation of large quantities of pus; but this is certainly not the only cause, as a chronic abscess may attain a very large size, and exist for years unattended by hectic as long as it remains unopened; nor after opening does hectic occur if the pus can be prevented from undergoing putrefactive changes, and the cavity can be well drained. It would therefore rather appear to be due to a chronic blood-poisoning, consequent upon the absorption of the products of putrefaction in small quantities at a time. *Symptoms.*—Hectic fever is characterized by profuse sweating, rapid wasting, nocturnal rises of temperature with morning remissions, and generally by diarrhœa and deposits of urates in the urine. The face is pale and pinched, the cheek flushed, the eye bright, the pupil dilated, the tongue red and dry at the edges, and the pulse rapid, small, and weak. The appetite gradually fails, the patient becomes weaker and weaker, and dies exhausted of diarrhœa, lardaceous disease, &c. *Treatment.*—The cause of the suppuration should be removed, or if this is impossible, the absorption of septic products should be as far as is practicable controlled by establishing a free drain to the suppurating cavity, and by preventing by the use of antiseptics the putrefaction of the discharges. At the same time the system must be supported by nourishing diet and stimulants, and the sweating combated by dilute sulphuric acid or atropine, and the diarrhœa by opium, catechu, or other astringents.

LARDACEOUS DISEASE is another of the complications that may follow prolonged suppuration consequent upon long-standing disease of the bones or joints. As the disease, however, perhaps falls more often under the notice of the physician than of the surgeon, the student, for a description of it, is referred to a work on medicine.

SINUS AND FISTULA.

When an abscess opens spontaneously, or is opened artificially, we have seen that the cavity usually fills up with granulations. Under some circumstances, however, as when an abscess is connected with dead bone, or contains a foreign body, or is formed in connection with a mucous canal or secreting gland, or its walls after opening are prevented from remaining in contact by muscular action, the abscess does not close, but degenerates into a suppurating track called a sinus or fistula. Though the terms sinus and fistula are often used synonymously, the former is generally applied to such a track when it is only open at one end, the latter when it is open at both ends. Although, perhaps, a sinus or a fistula more often owes its origin to the non-closure of an abscess, and is hence described here, it may also be the result of a wound, of ulceration, of sloughing, or of a congenital defect. Special forms of fistulæ, as fistula in ano, recto-vesical,

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salivary fistula, &c., will receive special notice under diseases of organs. Here generally it may be said that a sinus, and in some instances a fistula, is a long and often tortuous suppurating track, lined with a false membrane, and usually opening in the midst of prominent granulations. *Treatment.*—The cause should be sought, and if possible removed, and the walls of the sinus then pressed together by careful bandaging. The bandage should be so applied as to prevent the accumulation of pus in the deeper end, and the consequent reconversion of the sinus into an abscess. If this is found impracticable, a drainage-tube should be inserted and shortened daily as the sinus gradually fills up from the bottom. When the sinus has existed long, and the walls are callous and indurated, it should be stimulated by injections of tincture of iodine, nitrate of silver, or the like. Or the false membrane may be destroyed by chloride of zinc, the galvano-cautery wire, or the benzoline or actual cautery. These and such like means failing, the sinus should be laid freely open, the false membrane scraped away by a Volkmann's spoon, and the wound plugged with iodoform gauze or other antiseptic material to ensure healing from the bottom. Where the laying open of a sinus would involve important structures, as a large vessel, or necessitate an extensive wound, or is otherwise impracticable or unadvisable, a counter-opening should be made by cutting on the end of a long probe, and the sinus then drained by passing a drainage-tube at first through it, and subsequently in at each end, and gradually withdrawing the two portions as the sinus heals. At the same time that these local means are adopted, attention must be paid to the general health, as the intractability of a sinus may depend in part, or even entirely, upon some constitutional derangement. The treatment of special fistulæ is elsewhere described. (See *fistula in ano, &c.*)

Import.

ULCERATION AND ULCERS.

ULCERATION is another of the terminations of inflammation, and as we have already seen, merely differs from suppuration in that the one occurs in the substance of the tissues, the other on the free surface. In both there is minute disintegration and liquefaction of the tissues with degeneration and death of the infiltrating leucocytes; in suppuration, however, the dead products being unable to escape form an abscess, whilst in ulceration the broken-down tissues and pus are cast off as soon as formed as a discharge or ichor. An abscess may therefore be said to be a closed ulcer, an ulcer an open abscess. This molecular death of the tissues serves to distinguish ulceration from gangrene, in which the tissues die *en masse* and are cast off in the form of a slough. The two processes, however, are frequently combined. The softening and breaking down of a new growth, though not generally due to inflammation, are also spoken of as ulceration. Ulceration may occur in any tissue of the body. Here, however, our description will chiefly apply to the process as it affects the skin or mucous membrane. Let us first study the process as it may be followed with the naked eye in a portion of inflamed skin. The cuticle in the centre of the inflamed spot separates or is rubbed off, and a raw surface is thus left which gradually enlarges in depth and extent, leaving an angry-looking sore exuding a sanious discharge. Supposing the destructive process to now cease, minute red points called granulations spring up from the surface of the sore, and the discharge is replaced by healthy pus. The ulcer skins over from the margins, till the raw surface is thus covered in, and finally a *scar* only is left to mark the situation of the former wound.

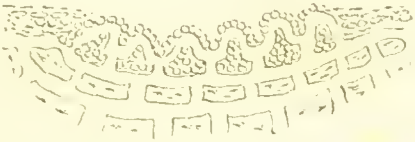

Fig. 3.—Diagram of ulceration. Formation of granulation-tissue. New capillaries growing out amongst the small raised cells from the old capillaries.

The Minute Changes are as follows :—The tissues at the focus of inflammation where stasis has already occurred become infiltrated with serum and leucocytes ; this leads to the increased proliferation of the cells of the cuticle, which are pushed forward before they have had time to assume their horny character, and the cuticle thus softened readily separates or is rubbed off, leaving the dermis raw and exposed. The infiltrated and softened tissues forming the surface of the sore become disintegrated by the pressure of the leucocytes, and are cast off in a molecular and partly liquid form, while those a little deeper become completely replaced by the leucocytes which here as in suppuration form a layer of vascular granulation-tissue (Fig. 3), essentially similar to that forming an abscess wall. When the cause of the ulceration is removed the circulation around becomes normal. the infiltration of leucocytes and serum ceases, and although the superficial cells of the granulation-tissue at first degenerate and are cast off as pus, under healthy conditions the granulation-tissue soon outbalances in its growth the superficial disintegration and thus fills up the ulcer. New epithelium is formed from the old epithelium at the margin of the ulcer, and gradually spreads over the surface of the granulations till the ulcer is finally skinned over. The granulations develop into fibrous tissue which slowly contracts, helping to reduce the size of the wound.

Causes.—Ulceration, except in the case of new growths, where it is brought about by the pressure of the infiltrating cell-growth, is the result of inflammation. For a fuller account of the causes of ulceration we must therefore refer the student to the causes of inflammation. Here it may briefly be said that the ulcerations of the integuments so common in surgical practice are generally the result of :—1. Injury, often slight, inflicted on parts the vitality of which is already lowered by poor living, advancing age, and chronic congestions due to varicose veins, long-standing, &c. 2. Certain morbid states of the system, such as are induced by syphilis and struma. 3. Pressure, especially when conjoined with a defective nerve-supply, as an example of which may be mentioned bed-sores occurring in cases of injury to the spinal cord.

The *treatment* of ulceration varies according to the local condition of the ulcer and the constitutional state of the patient, and will be discussed under Varieties of Ulcers. All that need be said in general is, that the cause should if possible be removed, all sources of irritation avoided, the constitutional state of the patient treated with appropriate remedies, and such dressings applied as are indicated by the local condition of the ulcer.

DISEASES OF CICATRICES.—After an ulcer has healed over and the granulation-tissue has been converted into fibrous tissue, this latter continues to shrink, leading to obliteration of the blood-vessels in the cicatrix and causing contraction and often distortion of the surrounding parts. Cicatrices differ from normal skin in that they are devoid of sweat-ducts, hair-follicles, sebaceous glands, and lymphatics, and being also but poorly supplied with nerves and vessels, are very apt to break down on slight provocation leading to a re-opening of the ulcer. Moreover, owing to their unstable nature they are liable to undergo certain changes and become the seat of eczema, hypertrophy, keloid, epithelioma and warty excrescences, and to be attended with itching, pain, and intense neuralgia.

ULCERS.

An ulcer is the term applied to an open sore produced by a loss of substance of the free surface of the skin or mucous membrane in the process of ulceration, or of ulceration and gangrene combined. The term, moreover, is sometimes extended to any open granulating wound the result of an injury or operation.

Varieties of Ulcers.—The various names given to ulcers are derived either from their local conditions and surroundings or from their specific cause. The characters of the specific ulcers, however, often become obscured by accidental local conditions, and these latter again are constantly changing from day to day, so that an ulcer which at one time would be called callous may at another be in a sloughing state. The following are examples of the chief types of ulcers, but in practice many minor shades of difference in the local appearances are met with, so that it may be difficult or impossible to assign a given ulcer to a particular type.

A. *Ulcers whose characters depend upon their local condition.*

1. *The simple, healthy, or healing ulcer.*—The edges are smooth and shelving, and extend in the form of a bluish-white film over the marginal granulations. The base is level, or nearly so, and covered with healthy granulations. The discharge is laudable pus, or if the ulcer is dressed antiseptically, and all irritation avoided, merely healthy serum. The surrounding skin is healthy. This

is the type that all ulcers assume when healing. *Treatment.* — Rest and protection by any light unirritating dressing is all that is usually required. When large, cicatrization may be promoted by skin-grafting. Small pieces of healthy skin, including the rete mucosum or actively-growing epithelial layer but not the whole thickness of the corium, should be snipped from the patient's arm or elsewhere by the skin-grafting scissors and placed at once with gentle pressure on the granulating surface of the ulcer, and retained there by suitable dressings until they have become adherent. After a few days the grafts often disappear, but this may only be owing to the loss of the horny layer of the epidermis which gives it its opacity. The active deeper layer which is transparent may still be there, and the grafts, if the process is successful, will become apparent in a few days, as in the course of growth the deeper cells are pushed forward and become horny. From each islet of epithelium thus grafted new epithelium spreads over the surface of the sore. The granulating surface of the ulcer must be healthy or the grafting will not succeed.

Sponge-grafting, when the ulcer is deep, has been recommended by Professor Hamilton, but in the cases in which I have seen it tried it has not been successful.

The exuberant or fungous ulcer is generally due to obstructed venous return from the granulations, the result of undue contraction of surrounding tissues, as seen, for example, after a burn. The edges are healthy, but the granulations rise up above the surface, and are turgid, dark red, redundant, and readily bleed. The discharge is purulent. *Treatment.*—Solid nitrate of silver should be rubbed over the granulations until they are reduced to healthy proportions.

The œdematous or weak ulcer generally occurs in connection with strumous bones or joints, but any ulcer may become œdematous if healing is delayed by the too long use of emollient applications. The edges and surroundings are generally healthy; and the granulations upraised, flabby, bulbous, semi-translucent, watery, and friable. The discharge is profuse and watery. *Treatment.* — Removal of the cause where possible; uniform pressure; and application of lotions of nitrate of silver, or like astringents.

The inflammatory and *inflamed ulcer.* —These terms are applied to ulcers in which the inflammatory phenomena are the most marked feature. The inflammation may depend on some constitutional disturbance consequent upon alcoholism, poor living, and the like; or it may be the result of local irritation applied to any ulcer whatever its previous character. For the purpose of distinction, the term inflammatory is applied to the former condition, whilst the term inflamed is generally restricted to ulcers of the latter class. Inflammatory ulcers have generally an irregular shape, the edges are ragged and shreddy, or abrupt or sharp-cut, the surrounding skin is red and œdematous, the base void of granulations, dry, livid-red, or covered with a serous or sanious discharge mixed with tissue-débris, and if the inflammation is very acute, yellow sloughs. When inflammation attacks a previously granulating ulcer, the granulations become florid and swollen, and generally slough, whilst the surrounding parts present the ordinary inflammatory phenomena. The *treatment* should consist of rest, the elevation of the part, the removal of all local irritation, the application of warm antiseptic lotions, as boracic acid, on lint, and attention to the constitutional state and regulation of the secretions.

The sloughing ulcer.—This is merely a severer degree of the former, and differs from it in that the inflammatory process is more intense and of a spreading and infective character. It is seldom met with except in connection with venereal disease. The ulcer spreads with great rapidity, the edges are undermined, inverted, and dusky red, and the base is covered by an ash-grey or black slough. There is commonly much pain and severe constitutional fever. The *treatment* is similar to that of the inflamed variety. Antiseptics should be freely used if the ulcer is foul, and opium given if there is much pain. When due to syphilis, the proper remedies for that affection should, of course, be given; but mercury should be used cautiously, or be altogether withheld till the sloughing has ceased.

The phagedænic ulcer, owing to improved sanitation and hygiene, and the more scientific treatment of wounds, is seldom seen at the present day, except in connection with venereal disease in persons whose constitution is thoroughly broken down by intemperance, poor living, and general neglect. The exciting cause is probably inoculation with a specific micro-organism. The edges of the ulcer are irregular, swollen, and undermined and of a dark, purplish, and dusky red colour. The surface is devoid of granulations, and covered with a dark blood-stained ichorous discharge, often mixed with sloughs. When the sloughing proceeds to any extent, the ulcer is spoken of as *sloughing phagedæna.* The ulcer spreads with fearful rapidity, and often destroys the whole organ, as the penis or vulva, and is attended with severe constitutional disturbance. *Treatment.* — The patient should be placed under an anæsthetic, the surface of the ulcer dried, and then thoroughly destroyed with fuming nitric acid. The continuous use of the hot bath is often of much service in phagedæna of the penis and vulva. Internally opium should be given in full doses, with tonics, nourishing diet, and when indicated, stimulants. Thorough ventilation and good hygiene generally are imperative.

The chronic, callous, or *indolent ulcer.*—This condition of an ulcer is the result of continued irritation and neglect, in consequence of which the edges become infiltrated with inflammatory material, which impedes the circulation and prevents healing. It is very common in the lower third of the leg in the poorer classes. The edges are smooth, white, callous, rounded, steep, and quite insensitive when touched. The skin around is generally congested or eczematous. The base is covered with a thin sanious discharge, whilst there are either no granulations, or such as are present are small, flabby, pale, and ill-formed. These ulcers often exist for years, and are usually attended with little pain, and though they are at times small, at other times extend nearly round the leg. They are often adherent to the fascia, periosteum, or bone. Old callous ulcers when subjected to continued irritation are apt, as age advances, to become epitheliomatous. *Treatment.*—The callous edges should first be softened by emollient dressings, and uniform pressure subsequently applied by a Martin's bandage, or by strapping and a bandage after Baynton's method. When very large, amputation under some circumstances may be called for.

The varicose and *eczematous ulcer.*—These terms are applied to any ulcer, whatever its other characters, when associated respectively with a varicose state of the veins, or an eczematous condition of the skin. Both conditions frequently occur together, and are generally dependent on a varicose state of the veins, and will be described under Diseases of the Veins.

The irritable or painful ulcer.—Though any ulcer may be irritable or painful, the above terms are generally restricted to a small painful fissure about the anus (see Diseases of Rectum), and to a small, superficial, generally congested ulcer, commonly situated about the ankle, and occuring chiefly in women beyond middle life. The pain is often intense, and is generally believed to depend upon the involvement of the nerve endings. *Treatment.*—The improvement of the general health, small doses of opium, and cauterization with nitrate of silver will often suffice to cure the ulcer. In inveterate cases an attempt may be made to divide the nerves subcutaneously after the manner of Hilton.

B. *Ulcers whose characters depend upon their specific origin.*

Tuberculous or *Strumous ulcers* are generally due to the breaking down of enlarged tuberculous lymphatic glands, the bursting of subcutaneous tuberculous abscesses, or the ulceration of the so-called tuberculous or strumous nodules. They are generally multiple and often confluent, forming an irregular indolent sore. The edges are pale, bluish-pink, thin, and undermined. The granulations are pale, œdematous, protruding, and readily bleed when touched. The discharge is thin, yellowish-green and scanty. Enlarged glands and cicatrices of ulcers are frequently present in their near neighbourhood. The cicatrices are generally raised, pale pink or white, whilst the skin is often puckered in around them. *Treatment.*—Constitutionally that for struma and tubercle. Locally the sore should be destroyed by paring away the edges and scraping the base with a Volkmann's spoon. The cicatrices may sometimes be dispersed by repeated blisterings or by subcutaneous division.

Syphilitic ulcers.—Primary ulcers or chancres are described under syphilis. Those occurring in the course of constitutional syphilis may be divided into the superficial and deep.

a. The *superficial* occur in the course of tubercular and pustular syphilides, and are often associated with patches of these eruptions on other parts of the body. They are usually circular or crescentic in shape, spreading by their convex margin, and healing on their concave. Their edges are sharp-cut and often surrounded by an areola of

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caused by syphilis

dusky redness; their base is but slightly depressed, and of a dark red colour, and is often covered by a yellow slough, or a rupial or ecthymatous scab. Several of these ulcers frequently coalesce, giving rise to a serpiginous or annular form of ulceration, which is very characteristic of syphilis. *Treatment.*—See SYPHILIS.

b. The *deep* are due to the breaking down of gummata. They are circular or oval in shape; their edges are steep, sharp-cut, slightly scooped out, and of a dull red colour; and their base is depressed and covered with a yellow wet-washleather-like slough and the débris of breaking-down tissue. They leave slightly depressed, white cicatrices, often surrounded with pigmentation. *Treatment.*—Constitutionally, iodide of potassium should be given in full doses, combined in obstinate cases with small doses of mercury; whilst locally a poultice may be applied till the slough has separated, and then black wash, iodoform, or the red oxide of mercury ointment.

Gouty ulcers are such as are met with over gouty parts. They are small and superficial, and the discharge as it dries leaves a chalk-like deposit of urate of soda on the surface of the ulcer.

The scorbutic ulcer. Should an ulcer exist in a person affected with scurvy, its surface becomes covered by a spongy, dark-coloured, strongly-adherent fœtid crust, the removal of which is attended with free bleeding, and is followed by the rapid reproduction of the same material.

Lupous, epitheliomatous, rodent, carcinomatous, and sarcomatous ulcers will be found described in the sections on Lupus, Tumours, &c.

GANGRENE OR MORTIFICATION.

Although gangrene may occur from causes other than inflammation, it is, as we have seen, one of its results, and is therefore described here. It differs from ulceration in that the affected tissue dies *en masse* instead of in a molecular manner.

General outline of the process.—Let us take as our type gangrene as it occurs in a superficial part as the result of inflammation. The part which was previously hot, red, painful, and swelled becomes cold, gradually falling to the temperature of the surrounding medium. The pain, which just before the gangrene sets in, is often of a peculiar burning character, ceases, and sensation is completely lost both to the touch and to other external stimuli. The skin, formerly red, becomes of a peculiar pale earthy colour, mottled in places with patches of green or red. Now the cuticle separates in the form of blebs, or can be removed by gentle touching, leaving the dermis below wet and slippery. A peculiar crepitant sensation is felt on pressure, on account of the formation of putrescent gases in the tissues, which, if cut into, are found stained and infiltrated with a red fluid. The part next becomes blackish-brown, and exhales the peculiar odour of decomposing animal matter. Supposing the process ceases to spread, ulceration is set up at the expense of the living tissue bordering upon the gangrenous part; a bright red line (the *line of demarcation* as it is called) is thus formed between the living and the dead; this deepens, and finally the gangrenous part is thrown off in the form of a *sphacelus* or *slough*, leaving a healthy granulating wound which cicatrizes in the usual way. The *minute changes* which occur during the above process are as follows:—The infiltration of the leucocytes is so excessive that the blood supply of the tissues at the focus of inflammation is cut off by the compression and thrombosis of the smaller arteries and capillaries, and the part loses its vitality and dies; the red corpuscles break down, and their hæmoglobin is dissolved in the albuminous fluid infiltrating the tissues, and stains them a deep red. Septic bacteria make their way through the skin and putrefaction sets in. The tissues disintegrate and liquefy, sulphuretted hydrogen and other putrescent gases are generated, and the part rapidly passes through changes similar to those it would undergo if it were no longer in connection with the body. Unless bacteria enter, the tissues undergo fatty changes (necrobiosis), not putrefaction. When the gangrene ceases to spread, the living tissues immediately in contact with the dead part, owing to the irritation of its presence, become intensely congested (hence the red line of demarcation) and, subsequently, in consequence of their infiltration with leucocytes, soften and break down into pus in the way described under Ulceration, and their cohesion being thus lost, the dead part is cast off. Hæmorrhage, during the process of separation, is prevented by the thrombi filling the vessels, which, subsequently, become permanently sealed as explained in the section on Hæmorrhage.

slow molecular death [illegible]

Granulations in the meanwhile spring up on the surface of the ulcer left on the removal of the slough, and cicatrization is finally effected. In the meanwhile, if the gangrene is at all extensive, or affects a vital organ, as a knuckle of intestine, it exercises a marked effect on the constitution. The vital powers are depressed, the heart's action is feeble, the pulse small, soft, and quickened, the tongue dry and brown, the lips are covered with sordes, and the appetite is lost; whilst later, as the products of putrefaction are absorbed into the system, symptoms of septic poisoning (*sapræmia*) set in.

The above may be taken as a type of what is called inflammatory gangrene. Gangrene, however, may result from causes other than inflammation, and the dead part, instead of becoming swollen and infiltrated with fluids, may shrivel up and become quite dry and mummified. Hence the division sometimes made into *moist* and *dry* gangrene.

The moist or dry appearance of the part depends upon whether the tissues at the time that gangrene supervenes are charged with blood as in inflammatory gangrene and in gangrene from venous obstruction; or, whether they are more or less deprived of blood, as in gangrene from the blocking of the main artery supplying the part. The two conditions sometimes run into one another, the dead part at first being moist, and subsequently becoming, as the fluids evaporate, more or less dry. The different appearances presented by the gangrenous part will be further described under Varieties of Gangrene, as it varies according to the cause producing it. The *causes* of gangrene, therefore, must first be considered.

Causes.—The immediate cause of gangrene, whether the process is induced by inflammation, as described above, or otherwise, may be said to be any agent which is capable of destroying the vitality of the tissues or cutting off their nutrient supply. The agents capable of inducing one or other or both of these conditions are very numerous. Some of them are in themselves alone sufficient to act in this way. For others, however, to become operative, certain prior changes in the tissues would appear to be necessary. The causes of gangrene, therefore, may be considered under the heads of predisposing and exciting.

The *Predisposing causes* are such as impair the vitality of the tissues, and render them less able to resist injurious influences. They, therefore, include those already given under Inflammation (page 5), and amongst them may be especially mentioned old age, feeble action of the heart, chronic congestion of a part, deteriorated blood as in diabetes and Bright's disease, and impairment or loss of nerve influence from injury or disease of the nerve-centres or nerve-trunks.

Exciting causes.—These may be considered under the following heads:—1. *Physical or chemical agencies*, which act by directly destroying the vitality of the tissues. Among these may be mentioned mechanical violence, as a severe crushing of part of a limb; excessive heat, as in burns and scalds; intense cold, as in frost-bite; chemical action from strong acids, alkalies, putrid secretions, and the like. Although these may act by directly killing the tissues of the part, their action is often aided by inflammation, as seen for instance in a crushed foot, where both the injury and the subsequent inflammation determine the death of the member. 2. *Inflammation* causes gangrene in part by the pressure of the inflammatory exudation and the thrombosis of the vessels cutting off the nutritive supply, and in part by the action of the irritant causing the inflammation. The latter is especially the case in the septic and infective inflammations, the noxa here being either the products of putrefaction (*ptomaines*) or micro-organisms (*bacilli* or *micrococci*). Some inflammations always terminate in gangrene, as carbuncle and malignant pustule. The manner in which micro-organisms act in producing gangrene is not determined. 3. *Obstruction to the arterial supply*, as from ligature of the main artery, embolism, thrombosis or rupture of the artery supplying the part, and spasm of the arterioles due to long ingestion of ergot. 4. *Obstruction to the capillary circulation* from thrombosis or pressure. As examples of this may be mentioned, bed-sores from pressure of the part between the bed and a point of bone; the death of the skin and bone in cellulitis and periostitis respectively from compression of the capillaries by the inflammatory effusion; local sloughing from the pressure of a splint or a new growth; cancrum oris from thrombosis of the capillaries, &c. 5. *Obstruction to the venous return* as seen in strangulated hernia, paraphimosis, tight bandaging, &c. Obstructed venous return, however, is generally associated with obstruction to the arterial supply as well.

The *Signs of gangrene* vary considerably according to the cause. The general symptoms in the acute inflammatory form have already been given in the outline of the process (page 34). Those of the special forms will be further mentioned under varieties of gangrene and elsewhere, as in the section on Cancrum Oris, &c.

The *Treatment*, like the symptoms of gangrene, depends so much upon the cause and nature of the gangrene, that its details can only be given under the special varieties. Here, however, it may be said that the general indications for treatment, whatever the variety, are—(1) To remove where possible the cause, as a tight bandage constricting a limb, putrefactive processes in wounds, tension, pressure, and so on. (2) To prevent gangrene, when threatened, from actually occurring by maintaining the warmth of the part, and endeavouring to relieve the embarrassed circulation by elevating the limb and by gentle friction when there is venous congestion; and (3) When gangrene has actually occurred, to check it spreading; to promote the separation of the dead from the living part, or remove it by amputation; to control as far as possible the formation of the products of putrefaction by keeping the part dry, and by the free use of antiseptics; to support the patient's strength; to counteract the deleterious effects on the constitution from the absorption of the septic poison; and to sooth pain by opium.

Varieties of gangrene.—We have just seen that gangrene is generally divided into the moist and dry according to the condition of the gangrenous part. Although these may be looked upon as more or less accidental conditions, depending upon the amount of fluid in the tissues at the time that gangrene supervenes, they are convenient for the purpose of classification, and are thus used here. As examples of moist gangrene may be mentioned—(1) Inflammatory gangrene, (2) Traumatic gangrene, (3) Hospital gangrene, (4) Phagedæna, (5) Cancrum Oris and Noma, (6) Carbuncle, (7) Bed-sores, (8) Diabetic gangrene. As examples of the dry—(1) Senile gangrene, (2) Gangrene from embolism or ligature of a main artery, (3) Gangrene from frost-bite, and (4) Raynaud's disease. Thus it will be seen that there may be made almost as many varieties of gangrene as there are causes producing it. Here only a brief account of a few of the typical varieties can be given; others, as Hospital gangrene, Phagedæna, Cancrum Oris, &c., are described in the sections on Septic Processes in wounds, Diseases of the Cheeks, Skin, &c.

TRAUMATIC GANGRENE may be divided into the local and the spreading.

Local traumatic gangrene is of common occurrence in surgical hospital practice. It may be the result of a severe injury, such as the crushing of a limb, whereby the tissues are killed outright or their vitality is so lowered that the blood extravasated from the wounded vessels is sufficient in addition to the lowering of their vitality to kill them. Again, it may be due to the rupture of a main artery or vein without any lesion of the skin. The *symptoms* in these cases are as follows:—The limb is cold and swollen, its sensibility is lost or blunted, and the pulse below the seat of injury is indistinguishable. As the patient recovers from the shock of the injury the circulation may return and all may be well; or the vitality of the part may become completely lost, the skin discoloured, and the other signs of putrefaction, already described, set in. Here the process is entirely a local one, and is dependent neither on constitutional disturbance, inflammation, nor septic agencies. But if the limb be not removed, the septic products will give rise to local inflammation and to constitutional signs of blood-poisoning. The *treatment* consists in amputating well above the gangrenous part as soon as the diagnosis is thoroughly established; but as long as it is doubtful whether the limb will not recover, the part should be handled with all gentleness, kept warm with cotton-wool, and placed at rest on a pillow, while stimulants should be administered, and tight bandaging and splints avoided, as such might be sufficient to determine the death of the part.

Spreading traumatic gangrene is a much more serious affection. Here the gangrene spreads with fearful rapidity towards the trunk, and is attended with severe constitutional symptoms. It occurs in two forms, one of which appears to depend upon the constitutional condition of the patient, and is unattended with inflammation; the other upon a septic or infective inflammation. The former occurs in persons whose vitality has been lowered by previous ill-health or internal injury. It usually comes on about the second or third day after an injury that has been generally though not necessarily severe. The limb becomes swollen, cold, and of an earthy or leaden hue, and the gangrene rapidly extends towards the trunk unattended with any local sign of inflammation; the patient falls into a typhoid condition, and sinks as the gangrene reaches the trunk. The second or septic form is most frequent after severe crushes or bruises of a limb, especially the lower, with injury of the bone, as compound fracture attended by extravasation and retention of blood or serum in the tissues. The gangrene begins at the edge of the wound and spreads up towards the trunk, but is preceded by a blush of inflammatory redness. In this case the gangrene is probably the result of a septic or infective process in the wound; the system becomes poisoned by the absorption of the septic or infective products; and the ordinary signs of septic intoxication (*sapræmia*) ensue.

Treatment.—In the first variety, depending on the constitutional condition of the patient, no treatment hitherto has been of any avail, as the gangrene almost invariably recurs in the flaps if amputation is performed. In the second variety, amputation, as far removed from the injury and gangrene as possible, should be resorted to early, so as to be well above the infiltrated tissues. It is of no use waiting for a line of demarcation, as one does not form. The strength must be supported by stimulants and fluid nourishment, and opium given to relieve pain. As the gangrene often spreads higher along the inner side of the limb than the outer, the flaps should in such cases be taken from the outer side so as to avoid the infiltrated tissues.

SENILE GANGRENE is generally taken as a typical example of the dry variety, but is often more or less moist when starting in inflammatory action. It is usually the result of calcification or of atheroma of the arteries and consequent clotting of blood on their roughened surface, a cause rendered more effective in old people by the weak propelling action of the heart, and feeble circulation through the lower limbs. It may occasionally be produced by embolism. It often begins apparently spontaneously as a black spot on one of the toes or the side of the foot; or it may start as a slight or diffuse inflammation induced by cutting a corn, a trivial injury of the foot, or ulceration of a bunion, and is often preceded by coldness and numbness, or cramp in the feet. It may gradually involve the whole foot and part of the leg, the parts becoming dry, black, and shrivelled. The process of separation is usually very slow, and at first is attended with very little constitutional disturbance. It usually terminates fatally. *Treatment.*—It is generally held that the parts should be allowed to separate spontaneously, the surgeon merely stepping in to help nature by severing the bone or any tendons that may remain after the softer tissues have separated. If this treatment is followed the limb in the meantime should be kept at a uniform temperature by wrapping it in cotton-wool; the odour of the gangrenous part kept in check by dressings of iodoform or dried charcoal; the strength supported by fluid nourishment and stimulants; and pain relieved and the circulation controlled by small doses of opium. The result of this treatment, however, is at the best unsatisfactory. It has been proposed by Mr. Hutchinson, therefore, to amputate at a distance from the gangrene, the objection to amputation in the neighbourhood being the liability of the flaps to slough, the risk of secondary hæmorrhage, and the difficulty of securing the arteries. Our experience, however, has hardly been sufficient at present to settle the point.

DIABETIC GANGRENE, as the name implies, occurs in persons the subject of diabetes. In some respects it resembles senile gangrene in that it usually occurs in moderately old people, starts in the lower extremity, frequently in the sole of the foot, and is generally the result of a trifling injury, and at times of a perforating ulcer. It spreads more rapidly, however, shows little tendency to be limited by a line of demarcation, and instead of being dry, generally remains moist. The *local treatment* is similar to that for senile gangrene, but amputation as a rule is inadmissible on account of the diabetes, for which the usual remedies may be given, care being taken however in their employment not to lower the patient's strength.

RAYNAUD'S DISEASE is a peculiar form of spontaneous gangrene usually affecting symmetrically the fingers, toes, or more rarely the ears. It generally occurs in children or young persons who have previously suffered for a longer or shorter period from intermittent attacks of numbness and coldness of the extremities, generally brought on by cold weather (*local syncope*), followed later in many cases by blueness and congestion, accompanied by burning pain (*local asphyxia*), which, in its turn, shows a tendency to run into actual death of the part (*gangrene*). The gangrene is usually of the dry kind, but in the toes and shins a bleb often forms, and the parts slough (*moist gangrene*). This condition is supposed to depend upon some disturbance of the vaso-motor nerve-centre inducing spasm of the arterioles, or in some cases upon a peripheral neuritis, but no organic lesion has yet been discovered. Hæmatinuria is frequently observed in association with it. It does not appear at present to have ended fatally. *Treatment.*—The constant descending current, as recommended by Raynaud, or placing the parts in an electric bath, has been attended with good results before gangrene has set in. When this has occurred it must be treated on general principles till the parts have separated.

TUBERCLE AND TUBERCULOSIS.

TUBERCULOSIS is the name given to an infective disease, due to the presence of tubercle in certain tissues and organs.

TUBERCLE may be defined as a new growth, depending upon the presence of the tubercle bacillus, and is classed in works on general pathology as an *infective granuloma.* Two forms are described, the grey and the yellow, the latter being a degenerated condition of the former. Tubercle may be limited to one set of tissues, or to an organ or part of an organ (*local tuberculosis*). Or it may be generally diffused throughout the whole body (*general tuberculosis*).

Structure of tubercle.—To the naked eye grey tubercle appears as semi-translucent greyish-white nodules of a gristly consistency, varying in size from a pin's point to a millet-seed. Hence the name "grey miliary granulations" which is sometimes given them. Yellow tubercle occurs as soft yellowish caseous masses, varying in size from a millet-seed to a filbert. Although at times all the tubercle in the organ may be grey, or all yellow, the two forms are often mixed, and the various stages from grey to yellow, from the central softening of the miliary tubercle to its complete conversion into a caseous mass, can be traced.

Microscopically a typical grey granulation when of some size is seen to consist of some smaller nodules aggregated together, whilst each of these again is composed of cells of various shapes and sizes, arranged in three zones (see Fig. 4). The inner zone is formed by one or more large branching so-called giant-cells, composed of a granular protoplasm, in which many large distinct oval nuclei containing nucleoli are found. The next zone consists of large single-nucleated cells, arranged between the branches or processes of the giant-cells, which ramify through the zone. These cells are called epithelioid, from their resemblance to epithelial cells. The third or

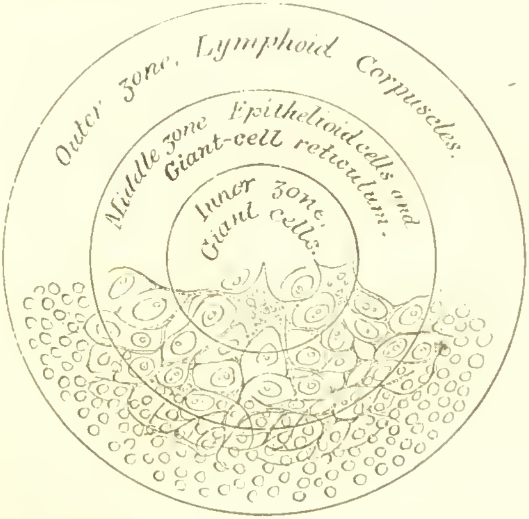
Outer Zone, Lymphoid Corpuscles.
Middle zone Epithelioid cells and Giant-cell reticulum.
Inner Zone, Giant cells.

FIG. 4.—Diagram of the minute structure of tubercle.

outermost zone consists of lymphoid cells, like ordinary leucocytes, scattered through a delicate reticulum of branched connective tissue cells, which is sometimes continuous with the processes of the giant-cells. There is no distinct line of demarcation between the outer zone of lymphoid cells and the surrounding tissues. The tubercle-nodule, though sometimes seated upon a small vessel, is itself completely non-vascular. The origin of the cells is still a matter of dispute; the lymphoid cells are generally thought to be leucocytes, the epithelioid cells to be derived either from the lymphoid cells or the lymphatic endothelium, and the giant-cells to be derived from either of the other two. Although this may be regarded as the typical microscopical appearance of a miliary tubercle, often neither giant-cells nor epithelioid cells are present, whilst both these may be found in chronic inflammations which are not tubercular. There is therefore no histological element which can be said to be distinctive of tubercle. The only reliable characteristic, according to recent authorities, is the presence of the tubercle bacillus. This micro-organism is a rod-like body, usually straight, sometimes curved, rounded at its ends, and about one-fifth its length in breadth. Alternating with the stained portions, are seen bright spots, which are generally believed to be spores. The bacilli are found both in the cells, especially those of the giant form, and in the intercellular substance.

Secondary changes.—Tubercle appears incapable of higher development, but is very liable to retrogressive changes. Thus the grey granulations may undergo fatty degeneration, and be converted into a soft opaque caseous mass of yellow tubercle (*caseation*). This in its turn may become encysted, or may undergo calcification, in both of which states it may remain harmless; or it may act as an irritant, and set up inflammation and suppuration in the tissues around, leading to the formation of an abscess, and subsequently on its bursting to an ulcer.

Cause.—The immediate cause of tubercle would appear from the experiments of Koch and others to depend upon the presence of the tubercle bacillus, as it was found that after many cultivations inoculation with the bacillus produced tuberculosis. For the bacillus to become operative, however, a suitable soil is probably necessary, and this may apparently be produced by 1, heredity; 2, the strumous diathesis; and 3, all circumstances that favour malassimilation and malnutrition. Youth may also be said to be a predisposing cause, as tubercle is more common in the young than in the old, though it may occur at any age. The bacillus probably gains admission either by the respiratory or digestive tract, or through an abrasion of the skin. It may then infect the lungs or intestines or neighbouring lymphatic glands, or enter the blood-vessels or lymphatics, and settle in some distant part of the body, as in a joint or the testicle. The reason for it affecting any special organ or tissue is not known, but it is thought to depend upon some previous lowering of the vitality of the part, as a sprain of a joint, a blow on the testicle, &c. Having alighted on a suitable soil, the bacillus is supposed to set up the tubercular process; this may, 1, remain localized for a longer or shorter time, and even become cured, or may cause inflammation and thus involve and destroy the whole organ; or it may, 2, become disseminated throughout the system by the lymphatics or blood-vessels, producing acute general tuberculosis. The brunt of the affection falls in this case either on the lungs (*acute phthisis*) or upon the membranes of the brain (*acute meningitis*).

A general though brief account of tubercle has been here given to prevent repetition when treating of tubercular diseases of certain organs. As a surgical affection, it is chiefly met with in the bones, joints, testicle, lymphatic glands, skin, larynx, and more rarely the bladder and rectum.

STRUMA OR SCROFULA.

The terms struma and scrofula are here used synonymously. To prevent confusion the former, as perhaps the one in more general use, will bo subsequently employed. By struma or strumous is understood a constitutional condition or diathesis, in which, on very slight provocation, chronic inflammations of certain tissues and organs, preferably skin, mucous membrane, lymphatic glands, bones, joints and testicle are set up, run an indolent course, and have a marked tendency to caseation and suppuration. By many pathologists, however, these chronic inflammatory processes, which are supposed to be characteristic of struma, are considered to be in themselves of a tuberculous nature, and dependent on the presence of the tubercle bacillus; whilst what is here called the strumous diathesis is regarded by them merely as a phase of ill-health or malnutrition, favourably disposing the subject to tubercular infection. Such observers, therefore, regard the terms strumous and tuberculous as synonymous. The histological characters and the general behaviour of many of the so-called strumous inflammations are no doubt in many respects similar, if not identical, to those which are on all hands regarded as tuberculous, and in many of them the tubercle bacillus has no doubt been found. In others, however, even after a careful search, it has not been discovered; and if, therefore, the presence of the tubercle bacillus is to be taken as distinctive evidence of tubercle, all the so-called strumous inflammations are not tuberculous. The constitutional condition, moreover, regarded by surgeons as strumous, is certainly something more, though difficult to define, than a mere state of debility or feeble health. For the present, therefore, the two processes, though intimately connected, can hardly be looked upon as identical. It would appear rather that strumous inflammations are of a simple chronic character, but form a nidus very suitable for the development of the tubercle bacillus, and that the strumous condition or diathesis predisposing to such inflammations is a constitutional state in which certain tissues and organs possess a feeble resisting power, or are excessively vulnerable, so that the slightest injury is capable of inducing the inflammatory process, and the most trifling irritation, as friction, tension, or pressure, is sufficient to keep it up.

The *causes* of struma are hardly known, but it is thought to be hereditary, and has been attributed to bad hygienic conditions of all kinds, as impure air, dark and damp dwellings, improper or insufficient food, &c. It is said to be especially common in children born of dyspeptic or phthisical, or very young or very old parents. Syphilis in the parent is also believed by some to be a cause. Struma, though most frequent in the young, is sometimes met with in the old (*senile struma*).

Symptoms.—The general symptoms which are usually regarded as strumous, irrespective of any of the local lesions, as enlargement of the tonsils or of the lympathic glands, eczematous eruptions of the skin, disease in the bones or joints, and catarrh of the mucous membranes, are thus given by Mr. Savory, who speaks of two chief forms:—"In the first, distinguished as the *sanguineous* or *serous*, there is a general want of muscular development; for although the figure may be sometimes plump and full, the limbs are soft and flabby; the skin is fair and thin, showing the blue veins beneath it; the features are very delicate; often a brilliantly transparent rosy colour of the cheeks contrasts strongly and strikingly with the surrounding pallor; the eyes, grey or blue, are large and humid, with sluggish pupils sheltered by long silken lashes; hair fine, blonde, auburn, or red; teeth white and often brittle; there is frequently a fulness of the upper lip and alæ nasi; the ends of the fingers are commonly broad, with convex nails bent over their extremities. Such persons usually possess much energy and sensibility, with elasticity and buoyancy of spirits; they often possess, too, considerable beauty. In this variety, with the same delicacy, the skin and eyes are sometimes dark. In the second, distinguished as the *phlegmatic* or *melancholic*, the skin, pale or dark, is thick, muddy, and often harsh, the general aspect dull and heavy; hair dark and coarse; the mind is often, but not always, slow and sluggish. Children especially, in whom the diathesis is strongly marked, are often distinguished by the narrow and prominent chest, the tumid and prominent abdomen; and the paste-like complexion; the limbs are wasted; the circulation languid; chilblains are common on the extremities; the mucous membranes particularly, and above all of them the digestive, are liable to morbid action; the breath is often sour and fœtid; the tongue is furred, and the papillæ towards the apex red and prominent; the bowels act irregularly, and the evacuations are unusually offensive; the digestion weak; the appetite variable and capricious."

An account of the lesions of the skin, mucous membranes, tonsils, lymphatic glands, bones, joints, testis, &c., that are regarded as local symptoms of struma, is given in the section on Diseases of Regions. All that need here be said is, that such lesions are of a very chronic and indolent nature; that they are set up by very slight and apparently inadequate causes, that they exhibit a marked tendency to suppuration and progressive destruction or undermining of the tissues, and but little tendency to repair; that they are often productive of much scarring and deformity, as when they occur as abscesses in the neck; that they are generally very obstinate and intractable as regards treatment; and that they often become tuberculous, and may then terminate in general dissemination of the tubercle through the body and death.

The *treatment* should be both constitutional and local. Thus the patient should be placed under as perfect hygienic conditions as possible, with residence at the seaside. The diet should be nourishing but unstimulating, with plenty of milk and cream, whilst cod-liver oil and the syrup of the iodide or phosphate of iron are especially indicated. The *local* treatment required for the various lesions that may be present will be given when describing these affections as they occur in special tissues and organs.

SYPHILIS.

Syphilis may be divided into 1, the acquired, and 2, the inherited or congenital.

ACQUIRED SYPHILIS is a constitutional disease due to direct inoculation with a specific virus. It is characterized by the appearance, after a certain period of incubation during which the poison is circulating in the system, of a local lesion at the seat of inoculation, followed by induration of the nearest lymphatic glands, and after a variable time by certain affections of the skin and mucous membranes and more rarely of the deeper tissues, and still later by fibroid changes in the tissues and viscera, or the formation of gummata which are exceedingly liable to break down and suppurate.

General outline of the disease.—Beyond perhaps a slight abrasion, which heals in a few days, and is possibly thought no more of, nothing is probably noticed till about three weeks to a month. Attention is then called to the part by a slight irritation, and a red papule may be noticed which slowly enlarges, becomes indurated at the base, and perhaps ulcerates. This papule or ulcer is called the primary *chancre*, and the period which intervenes between the date of inoculation and its appearance the *period of incubation*. The induration of the sore increases, and the neighbouring glands become hard and shotty. In from six weeks to three months from the date of inoculation, affections of the skin and mucous membrane begin to show themselves, and are known as *secondary* manifestations. The period between their appearance and the induration of the chancre is sometimes called the *secondary incubative period*, during which time malaise, pain in the limbs, lassitude, &c., are noticed. The secondary affections are symmetrical, and though generally confined to certain superficial changes in the skin and mucous membranes, at times attack the deeper structures, as the bones, iris, &c. The secondary stage may last from two months to two years, and no further changes may manifest themselves, the disease appearing to be worn out; or after a few months or years of apparent cure, further changes, known as *tertiary* symptoms, make their appearance. The tertiary affections are asymmetrical and not only attack the superficial parts, but are especially common in the deeper structures, as the bones, periosteum, and viscera. They consist in the formation of gummatous material in the skin and mucous membrane, which is very prone to break down and ulcerate; and gummatous swellings in the bones, periosteum, and viscera, leading to suppuration, fibroid changes, necrosis, serious con-

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tractions, paralysis, &c. They may last for years or even for life, and not infrequently terminate fatally when involving vital structures. It should be thoroughly understood, however, that there is no hard and fast line between the secondary and tertiary stages of syphilis. The one may merge into the other, or the secondary symptoms may last into the period usually assigned to the tertiary, whilst the latter may show themselves a few months after the first appearance of the sore. Syphilis, like the exanthemata, as a rule confers immunity upon the patient from a second attack, although in rare instances such has been known to occur. As long as the patient shows secondary manifestations of syphilis, it will probably be transmitted to any offspring. Hence, as a rule, a patient should not be allowed to marry for fully two years after the disappearance of the secondary symptoms.

PRIMARY SYPHILIS.—The primary or infecting chancre, or hard sore as it is sometimes called, though most often met with on the genitals, may occur on any part of the body exposed to infection, and hence is not infrequent on the fingers of accoucheurs, the lips, nipple, &c. On the genitals its most frequent situation is on the prepuce just behind the corona glandis in the male, and on the inner surface of the labia in the female; but it is often met with on the glans, the skin of the penis, and just within the urethra; more rarely on the vaginal walls and os uteri. It is commonly produced by direct contact with another chancre, or a mucous tubercle or other secondary lesion; but it may also be contracted indirectly in many ways, as by drinking out of an infected vessel, or by inoculation with infected lymph in vaccination. The exact nature of the virus is not known, but is believed by many to be a specific form of bacillus. It is probable that it is generally inoculated through a crack or abrasion, except, in situations where the skin or mucous membrane is very thin and delicate. The period of incubation varies from ten days to six or seven weeks or even longer. When, however, the syphilitic virus is inoculated in the pure state it usually gives rise to no signs till three to five weeks, when a small papule will be noticed, which enlarges and becomes indurated at the base, and may either remain as an indurated nodule throughout or if irritated change into a small ulcer. Not infrequently, however, the virus may be conveyed in the pus of a non-infecting or soft chancre, under which circumstances a soft chancre will form in two or three days whilst the syphilitic poison is still circulating in the system, and after the incubative period is passed will manifest itself locally by induration about the base of the soft sore, or, if this is healed, by an indurated nodule at its former site. The characters of an infecting chancre vary. In the typical form (*Hunterian chancre*), it is raised though slightly depressed at its centre, whilst its surface is either glazed or covered with epithelial débris or scanty secretion; there is scarcely any inflammation, but marked and sharply circumscribed induration about its base. The induration, however, may be absent in chancres on the glans penis and on the female genitals, and is seldom well marked in chancres on parts of the body other than the genitals. It must be borne in mind, moreover, that a non-infecting sore when inflamed may be attended with some inflammatory induration, and hence may be mistaken for an infecting sore. This inflammatory induration, however, is diffused, and fades away into the surrounding parts; whereas the induration of an infecting sore feels as if a piece of cartilage had been inserted under the skin. Infecting chancres, though usually single, may be multiple if several spots are inoculated at the same time, all then appearing at the same stage of development; but when a primary chancre has once declared itself, showing that the system is impregnated with the poison, other chancres can no longer be produced by inoculation in the same patient. The duration of a primary chancre varies. It usually disappears quickly under the influence of mercury, but if untreated may last for many months. The lymphatic glands generally become enlarged about the same time as the induration of the primary sore, a condition known as *indolent bubo*. Thus, if the chancre is on the genitals or about the anus, the inguinal glands are those affected; if on the finger, the epitrochlear or axillary; if on the lip, the submaxillary. They have a hard, shotty feel, remain distinct from each other, are not adherent to the skin, and do not, as a rule, suppurate. The induration is commonly greater in the inguinal glands than in those of other situations; but, at the same time, the enlargement is not so marked. The induration may subsequently affect all the glands of the body, especially the posterior chain in the neck. If the chancre is irritated or inoculated with pus from a soft chancre, or a soft chancre has formed simultaneously, then a *suppurating bubo* may occur.

SECONDARY SYPHILIS.—The secondary symptoms consist of certain affections of the skin and mucous membranes, general enlargement of the lymphatic glands, and more rarely of inflammation of such deeper structures as the iris and periosteum. They generally set in from six weeks to six months after the appearance of the primary sore. They may assume a very severe, or a very mild form, or they may not occur at all, or may be so slight as to be overlooked.

The *skin eruptions* may take various forms. The earliest to appear is usually a *roseolous* rash over the chest and abdomen. It is generally accompanied by a congested condition of the mucous membrane of the fauces, giving rise to a slight sore-throat. This rash is produced merely by local congestion, and hence fades on pressure and usually disappears in a short time. But should the congestion continue, some infiltration of the skin may occur, and the epithelium take on increased growth, and be thrown off in the form of scales, the eruption being then known as a *scaly* syphilide or *psoriasis*. Should further infiltration occur, a *papular* syphilide, or *lichen*, may be produced; or if the process is more acute, serum may be exuded, and raise the cuticle in the form of small vesicles, or even of large blebs, conditions which are spoken of as *vesicular* syphilides or *eczema*, and *bullous* syphilides or *pemphigus* respectively. Both, however, are rare, and the latter seldom occurs, except in congenital syphilis. Again, in situations where the parts are moist, as about the mouth, anus, and scrotal folds, the papillæ become succulent and the epithelium sodden, forming *condylomata* or *mucous tubercles*. Where such occur between the toes, ulceration may ensue (*rhagades*); but this condition is not common, except as the result of uncleanliness. Condylomata appear as low, soft, flattened, sessile elevations of a whitish colour, with a smooth surface, covered by a moist secretion, and often of considerable size. They are intensely contagious, and when occurring where two skin surfaces are in contact, as about the anus and labia, are usually symmetrically placed on either side. Still later, especially where the patient is debilitated, the vesicles may be converted into pustules (*pustular syphilide*) by the escape into them of wandering leucocytes; while the pustules again may dry into scabs, which fall off, leaving no scar beneath (*syphilitic ecthyma*); or if the patient is cachectic, or his constitution broken down, ulceration may ensue beneath the scabs (*rupia*). The appearance presented by rupia is peculiar. As the ulceration proceeds in depth and extent, larger and larger scabs are successively formed beneath those above, which are thus pushed forward, giving the mass the appearance of a limpet-shell. Each rupial spot is surrounded by a dusky-red areola, and on the separation of the scab, a foul circular ulcer is left, which, on healing, leaves a permanent scar. Rupia by some is regarded as an early tertiary, rather than as a late secondary, affection. With the exception of rupia the eruptions in syphilis resemble those due to non-syphilitic causes. They are, however, all modified by their coppery or raw-ham colour, by more or less surrounding pigmentation, by their symmetrical arrangement, by the circular or crescentic shape of the patches, by the absence of itching, by the absence of the large silvery scales seen in ordinary psoriasis, by their predilection for certain situations—*i.e.*, the chest and abdomen, between the shoulders, the back of the neck, the forehead, about the roots of the hair, the palms and soles and the flexor aspect of the limbs; and lastly, by their polymorphism—*i.e.*, their mixed character, the eruption being here papular, here scaly, here pustular, &c. The affections of the *mucous membranes* are similar to those of the skin, and are also usually symmetrical. At first, they consist of mere congestions, later of infiltrations with overgrowth and soddening of the epithelium (*mucous tubercles*), and subsequently of superficial ulcerations from the breaking down of the infiltrating inflammatory exudation. Mucous tubercles are especially common about the palate and fauces, side of the tongue, lips, and cheek, and appear as slightly elevated whitish-looking patches, giving the part somewhat the appearance of having been rubbed over with nitrate of silver. The ulcers, which occur in similar situations, particularly about the tonsils and corners of the mouth, are usually of a crescentic shape, with sharp-cut edges, and are quite superficial. Similar mucous patches and ulcers may occur in the larynx or about the anus or in the rectum.

During the later secondary stages, besides the superficial eruptions and ulcerations which may still be present, the deeper structures may become involved. Amongst these may be mentioned the iris, periosteum, bones, joints, ear, and testicle. The lymphatic glands, not only those nearest to the primary sore, but over all the body, become affected, the posterior cervical more particularly so. This condition is of service in diagnosis; but as it gives rise to no symptoms, it is generally overlooked by the patient. Syphilitic iritis is especially characterized by the presence of nodules of lymph on the iris, the effusion into the anterior chamber, the comparatively small amount of pain, and its amenability to mercurial treatment. But the irregular pupil, discoloured iris, circumcorneal zone of congestion, photophobia, and patches of pigment on the lens, are also present as in other forms of iritis. The periostitis seldom gives rise to the distinct nodes so common in the tertiary stage; otherwise the symptoms are similar. The joint-affections are like those in rheumatism, and exhibit nothing very characteristic. Epididymitis and orchitis are occasionally observed, and are then generally symmetrical, thus differing from the gummatous affections of the testicle in the tertiary stage.

The general health usually suffers, the hair becomes thin (*syphilitic alopecia*), and the patient anæmic. At times severe cachexia ensues, attended by much wasting and prostration.

Tertiary syphilis.—The symptoms of the tertiary stage commonly occur after a period of apparent cure, sometimes within a few months after the cessation of the secondary symptoms, at other times not till after many years. Occasionally, however, they may be manifested within a few months of the primary sore, *i.e.*, during the period usually assigned to the secondary stage. Moreover, between the termination of the secondary and the onset of the tertiary, certain skin eruptions, enlargements of the testicle, choroiditis, inflammations and ulcerations of the tongue, and psoriasis of the palms may occur, and have been spoken of as "reminders." They are by some regarded as constituting an intermediary stage. The tertiary affections proper are of a more serious nature than the secondary, and show no tendency to spontaneous cure. They depend upon chronic inflammations in various tissues and organs, leading to the formation of granulation-tissue (*gummata*). The gummata may undergo caseation and break down, producing when situated in the subcutaneous and submucous tissue characteristic ulcers; or they may continue for indefinite periods, or be slowly absorbed under appropriate treatment, leaving fibroid thickenings and scarrings in the capsules and substance of the affected organs. These gummata vary in size from a pea to a walnut, and are intimately blended with the surrounding tissues. They consist, roughly, of three zones; in the central, the cells are breaking down and undergoing fatty change; in the next zone the cells are contained in a fibrillated matrix; in the outer zone numerous vessels ramify among the cells. The breaking down of the central portion is attributed to changes in the vessels causing a diminution of their calibre or complete thrombosis, whereby the blood-supply of the central zone is cut off and degeneration consequently ensues. Amongst the most common of the tertiary lesions may be mentioned—1, chronic gummatous inflammation of the periosteum and bones, leading to the formation of nodes, caries, or necrosis, and giving rise, as when attacking the nose, to horrible deformity; 2, gummatous infiltration of the skin and mucous membrane (*tubercular syphilides*) terminating in serpiginous ulceration; 3, gummatous swellings in the subcutaneous and submucous tissue which may break down, forming deep ulcers the cicatrization of which causes severe contractions, as for instance those seen in stricture of the pharynx, glottis, and rectum; 4, gummata in the muscles; 5, gummata in the tongue, producing scarring and ulcers apt to terminate in epithelioma; 6, affections of the nervous system leading to paralysis; 7, affections of the arteries leading to embolism or aneurism; and 8, gummata, followed by contraction and fibroid changes, in the liver and other viscera, producing jaundice, cirrhosis, phthisis, &c. The various tertiary lesions will be further described under diseases of the special tissues and organs; for those affecting the lungs, liver, kidneys, and nervous system a work on medicine must be consulted. Here it must suffice to say that the tertiary lesions are usually asymmetrical; that they are not, as a rule, contagious, though locally infective; that they are chronic in their course; and that they often prove fatal by affecting important organs, as the lungs or brain, or by causing constriction of a passage, as the larynx or rectum.

The *treatment* of syphilis necessarily varies according to the constitutional condition of the patient and the stage of the disease. The *primary sore* requires no other *local* treatment than the application of iodoform or black-wash and protection from irritation. Some, however, still advocate its destruction by caustics or complete excision, and further recommend removal at the same time of the nearest indurated glands. The majority of Surgeons regard such treatment as useless, since they believe that the induration of the primary sore is merely an indication that the disease is already established in the constitution. Moreover, excision has repeatedly failed to prevent the occurrence of secondary symptoms. *Constitutionally*, mercury in some form is by the majority of Surgeons thought to be necessary in all cases. It must, however, be given with caution to strumous and tuberculous subjects, and to persons whose constitution is impaired by dissipation, alcohol, or bad living. It should be withheld in chronic Bright's disease; nor should it be forgotten that some patients exhibit a peculiar idiosyncrasy, in that they are violently salivated by a grain or two of the drug. Mercury may be given 1, by the mouth; 2, by inunction; 3, by fumigation; and 4, by subcutaneous injection. It is, as a rule, perhaps best given by the mouth, either in the form of a pill or mixture. As a pill, the green iodide in doses of $\frac{1}{2}$ a grain to 1 grain, combined with $\frac{1}{8}$ to $\frac{1}{16}$ of a grain of opium to prevent purging, may be given two or three times a day, or the mercury and chalk powder in doses of from 2 to 3 grains, or calomel or blue-pill may be substituted for it. As a mixture, the perchloride in doses of $\frac{1}{32}$ to $\frac{1}{16}$ of a grain, combined with ammonia, is very useful. The green iodide possesses an advantage, in that the iodine prevents an accumulation of mercury in the system. Where mercury given by the mouth causes much irritation of the bowels, it may be used in the form of an inunction, half a drachm to one drachm of mercurial ointment being rubbed into the inner part of the thigh or the axilla night and morning, the parts being thoroughly washed every day to prevent the ointment accumulating in the sweat ducts, &c. This is a rapid way of bringing the patient under the influence of the drug, as is also fumigation with calomel or other preparation of mercury, though this latter method may be followed by violent salivation. Subcutaneous injection appears to possess no special advantages over the other methods, and is apt to cause sores or abscesses at the point of puncture. The effects of the mercury should be judged by its action on the primary sore. Under its influence the induration rapidly disappears, and the rash fades. It should never be pushed beyond causing a slight soreness of the gums, the formation of a red line on their free margin, and tenderness on biting. Should salivation occur, the mercury should be immediately stopped, a gentle purgative given, the mouth rinsed with a gargle of chlorate of potash, and iron taken internally. The mercury should also be intermitted for a few weeks or so at a time if symptoms of depression come on. During the mercurial course the patient should avoid chills and abstain from alcohol, fresh fruit, and food liable to disturb the digestion and set up diarrhœa. The course may with advantage be continued for a year or more, and on its termination iron, tonics, and cod-liver oil should be given, whilst change of air and the baths of Aix-la-Chapelle or Harrogate will be found beneficial. If mercury cannot be taken or is contra-indicated, iodide of potassium with a tonic treatment may be tried. During the *secondary stages* mercury should still be continued internally. Locally, condylomata are best treated by dusting them with equal parts of calomel and oxide of zinc, under which they dry up very rapidly. Mucous tubercles about the fauces may be gargled with black-wash; superficial cracks and ulcers on the lips, tongue, &c., may be touched with a strong solution of nitrate of silver, or a lotion of bicyanide of mercury or chromic acid. Iritis should be energetically treated by mercury, or if this is already being given, the dose should be increased, whilst locally atropine should be dropped in the eye, and if there is much pain and the congestion is acute, leeches or blisters should be applied to the temple. In the *tertiary stages* iodide of potassium has the most marked effect. It may often be advantageously combined with ammonia, quinine, iron, or cod-liver oil, or even with small doses of mercury. If badly tolerated kola chocolate may be given with it, or iodide of sodium or ammonium substituted for it; but the treatment of tertiary syphilis will be referred to more in detail under the Diseases of Tissues and Organs.

Should phagedæna occur, it must be energetically treated by the continuous hot bath, or the destruction of the ulcer with the fuming nitric acid or acid nitrate of mercury.

CONGENITAL OR INHERITED SYPHILIS is syphilis transmitted to the offspring by one or both of the parents, and must be distinguished from syphilis contracted by the infant coming in contact with a chancre on the genitals during birth, which would be a case of acquired syphilis. *Cause.*—The poison is transmitted through the spermatozoa of the father, or the ovum of the mother, not by direct inoculation and the formation of a primary chancre as in the acquired form. *Symptoms.*—The child is usually born healthy, and though the virus is present in the system, the disease does not manifest itself as a rule till the fourth or sixth week. In rare instances, however, infants are born with well-marked signs of syphilis; and at times the affection does not show itself till much later in life. But in the latter case the symptoms are those of the tertiary stage, not those of the secondary stage delayed. The symptoms in a typical case usually set in, with a chronic catarrh of the nasal mucous membrane, popularly known as the *snuffles*, followed by a rash on certain parts of the body, and mucous tubercles and superficial ulcerations about the mouth and anus. The catarrh may simulate merely a cold in the head, or be attended with a muco-purulent discharge, and cause obstruction to respiration and difficulty in sucking. The eruption, like that of the secondary stages of acquired syphilis, is symmetrical, and of the same peculiar coppery or raw-ham colour. It is most common about the nates and genitals, where it is usually erythematous in character, and on the palms of the hands and soles of the feet, where it is commonly squamous. But it may be papular and at times bullous, or pustular. A well-marked mucous tubercle or condyloma about the anus is pathognomonic of the disease. These symptoms are frequently, though not invariably, accompanied by marasmus and wasting, the child looks shrivelled and old, the skin earthy and dry, whilst the hair may fall off, and the nails, iris, periosteum, and bones may be affected as in the acquired form. At this period death is far from uncommon. Usually, however, and especially under a mercurial course, the symptoms gradually subside, and by the end of the first year disappear altogether and no further manifestation of the disease may occur throughout life. But frequently after several years of immunity certain tertiary affections show themselves, the chief of these being interstitial keratitis, periostitis, and osteitis, followed by necrosis, disease of the ear often ending in total deafness, ulceration about the palate, chronic synovitis of one or more of the joints, and the formation of gummata in the viscera, testicle, &c. Along with these, certain important diagnostic symptoms the result of the former secondary lesions, may be present, viz., 1, a depressed and widened condition of the bridge of the nose due to the influence of the nasal catarrh upon the development of the nasal bones and septum; 2, radiating scars about the angle of the mouth, the result of the cicatrization of the former ulcers; 3, a peculiar conformation of the skull, the result of the former bone-lesion, consisting chiefly in a furrow above the eyebrows, a square forehead, and prominent frontal eminences; and 4, a characteristic appearance of the permanent central incisor teeth, consequent upon the action of the stomatitis upon them while yet soft and uncut. The distinctive sign of syphilis in these teeth is a slight crescentic notch in the biting edge. They are also generally dwarfed, especially in width, their angles are rounded off, and their sides convex in outline. These appearances must be distinguished from those due to the action of mercurial stomatitis, the teeth so affected showing horizontal markings, or honeycomb excavations in the enamel (compare Figs. 5 and 6).

The bone-lesions of congenital syphilis were until recently overlooked, or confounded with those of rickets, which they much resemble. Two forms are described, the *osteophytic* and the *atrophic.* In the *osteophytic* the cranial bones present localized and symmetrical thickenings (*Parrot's nodes*) in the region of the frontal and parietal eminences (*the natiform or hot-cross-bun-like skull*), and the long bones subperiosteal enlargements. In the *atrophic* the cranial bones, especially in the occipital region, are thinned or locally absorbed, so that the brain is only covered at these spots by a thin membrane (*osteoporosis, craniotabes*), and the long bones are enlarged at their epiphyses by the production of ill-formed bone and the absorption of the normal bone. These lesions are usually transitory, and generally give rise to little inconvenience; but, at times, separation of the epiphysis may occur, with inflammation of the neighbouring joint; and when several bones are affected, the child may be so chary of movement on account of the pain it causes that paralysis may be simulated.

Treatment.—In the early stages mercury generally acts like a charm. It is best administered as an inunction by putting half a drachm of blue ointment on the binder of the child and allowing it to be thus rubbed into the skin. Or it may be given in the form of mercury and chalk in doses of from half to one grain, but is then apt to cause diarrhœa. Mercury, however, should be given with caution if there is much marasmus, and discontinued as soon as the symptoms have cleared up, lest mercurial stomatitis be induced and the permanent teeth suffer in consequence (Fig. 6). The child should be well and

wasting.

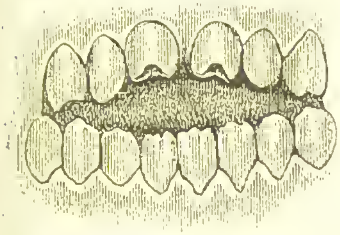

FIG. 5.—Syphilitic teeth (after Hutchinson).

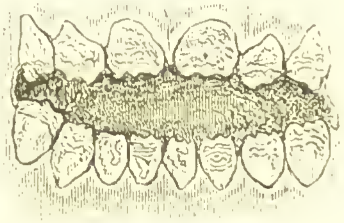

FIG. 6.—Mercurial teeth (after Hutchinson).

carefully fed during the mercurial course, and small doses of cod-liver oil may often be taken with advantage. If the mother is unable to suckle the infant it must be brought up by hand, not by a wet nurse, for fear of her nipple becoming affected with a primary chancre, a danger the mother herself does not run, even although she has exhibited no signs of syphilis. In the latter stages, as in those of the acquired form, iodide of potassium is indicated, and may frequently be advantageously combined with small doses of mercury, where the later lesions, as is too often the case, prove intractable. Lastly, should syphilis be suspected in either of the parents during the period of gestation, mercury should be administered to the mother; whilst a caution should be given to both parents after the birth of a syphilitic infant for the sake of any future offspring.

HÆMOPHILIA.

HÆMOPHILIA, or the hæmorrhagic diathesis, is a condition in which bleeding is prone to occur spontaneously or on the slightest provocation, and is very difficult to arrest. The cause is unknown. The affection, however, appears to be hereditary; it often occurs in members of the same family, and nearly always in the males, although it is almost invariably transmitted through the female line. The pathology of the disease is obscure, and except that the arteries have been found thin, and the left ventricle hypertrophied, nothing abnormal has been discovered either in the tissues or in the blood. The bleeding may be started by the most trifling injury, such as a mere scratch of the finger, the extraction of a tooth, or a bite of the lip or tongue. Or it may occur spontaneously, when it is sometimes preceded by flushings of the face and throbbing of the arteries, and then commonly takes the form of epistaxis, or of extravasations beneath the skin, of bleeding from the gums or intestines, or of effusion into a joint. Where the result of a traumatism, the blood, except a large artery is wounded, oozes from the injured surface in a steady, continuous, and uncontrollable stream. The bleeding may last for weeks and then cease spontaneously, leaving the patient in an anæmic condition, from which, however, he may speedily recover; or it may terminate fatally. Successive attacks are common at varying intervals, and to one of these the patient generally succumbs. Should, however, he survive the period of puberty, there is a fair chance of the tendency to bleed decreasing with advancing years. The *treatment* consists in placing the patient at perfect rest in the recumbent position, and in elevating the part when the bleeding comes from a limb. Ligature, the actual and galvanic cautery and acupressure only do harm by increasing the size of the wound; and cold, in the form of ice, is of doubtful benefit. When the blood comes from a tooth-socket a plug of perchloride of iron may be applied. Internally, such drugs as ergotin, acetate of lead, gallic acid, and sclerotic acid, are recommended, but do not appear to have much power in controlling the bleeding.

TUMOURS.

A TUMOUR, as generally understood, is a swelling in some part of the body, not depending upon inflammation or mere hypertrophy of pre-existing tissue, and showing no tendency to undergo spontaneous cure or to yield to the action of medicines. In *structure* a tumour consists of elements resembling those of the normal tissues of the body either in the mature or in the immature state. Thus a tumour may be composed of bone, cartilage, fat, &c.; or of cells like those constituting the epithelium; or of elements indistinguishable from the rudimentary tissues found in the embryo. A tumour may resemble and continue to grow in the tissue in which it originates, merely displacing the surrounding tissues, as for example, a fatty tumour growing in the subcutaneous fat. It is then called homologous. Or a tumour may originate in one tissue, and retaining the type of that tissue, invade another, as an epithelioma infiltrating connective tissue, muscle, or bone; it is then spoken of as heterologous. Homologous tumours have generally the structure of the mature tissues of the body, as fibrous tissue, fat, bone, &c., and are usually innocent. Heterologous tumours, on the other hand, commonly consist of cells like those of the more lowly organized or the immature tissues (*epithelium*, *embryonic tissue*), and are generally malignant. The lower the organization of a tumour the greater, as a rule, is its malignancy, although, as pointed out by Mr. Butlin, "tumours of similar structure differ widely in their power of mischief according to the part of the body in which they originate."

Development.—All tumours are believed to arise by the multiplication of pre-existing cells, and to retain throughout their growth the type of the cell from which they spring; hence they are spoken of as connective-tissue or as epithelial growths, according as they originate in the connective tissue, or in the epithelium. Tumours arising in the connective tissue at first consist entirely of small round cells, with a scanty amount of intercellular substance; that is, they resemble embryonic connective tissue. They may retain this structure throughout their course (*sarcoma*), or they may become more highly developed and assume the structure of the more specialized connective tissues. Thus, fibrification may occur and the tumour take the form of mature fibrous tissue (*fibroma*); or chondrification or ossification may ensue, or fat be deposited in the cells, and the tumour become indistinguishable in structure from normal cartilage, bone or fat (*enchondroma*, *osteoma*, *lipoma*). Tumours springing from epithelium not only retain the character of epithelium, but likewise that of the special form of epithelium from which they are derived. Thus they resemble squamous epithelium when derived from the skin, spheroidal epithelium when from a gland.

Cause.—Little is actually known of the etiology of tumours. They have been variously attributed to such *local* causes as long-continued irritation, chronic inflammation, injury, the presence in the completely developed tissues of embryonic remains which from some unexplained cause have taken on active growth later in life, and the action of some unknown form of parasite or ferment. They have further been ascribed to such *constitutional* causes as hereditary predisposition, the activity of tissue-growth in early life, the slow degeneration of advancing age, and the lessened resisting power of the tissues that may be occasioned by such depressing influences as grief, anxiety, or mental strain. Residence in certain localities is considered by some observers to be a predisposing cause of some forms of malignant tumour.

Clinical course.—Clinically, tumours are spoken of as innocent and malignant. I. *Innocent tumours* as a rule grow slowly, and resemble the fully-formed tissues of the body, and usually those amongst which they grow. They are generally encapsuled, circumscribed, and freely moveable, merely displacing the tissues around, not infiltrating them. They do not involve the lymphatic glands, nor become disseminated in distant organs; neither do they recur if completely removed. They may, however, attain a large size and destroy life by pressing upon a vital organ, or in other ways interfering with its functions. II. *Malignant tumours*, on the other hand, grow rapidly, do not resemble the fully-formed tissues in structure, and differ markedly in appearance from the tissues in which they grow. They are generally non-encapsuled and infiltrate the surrounding parts, whether these be muscle, fat, bone, &c., and in consequence become more or less fixed and adherent. They frequently involve the lymphatic glands, and become disseminated through the body by means either of the lymph- or blood-stream. They usually recur after removal, in the scar, in the corresponding lymphatic glands, or in internal organs, and sooner or later give rise to a general cachectic condition known as the *cancerous cachexia.* Death is commonly due to exhaustion caused by the local ulceration, hæmorrhage and pain, combined with the mental distress, and the general interference with nutrition induced by the rapid growth of the tumour and its dissemination through internal organs.

Secondary changes are common in tumours, especially in those of more rapid growth. Thus a tumour may become inflamed, or may ulcerate, or undergo fatty, mucoid, colloid, pigmentary, or calcareous degeneration; or as the result of these changes, or of hæmorrhage into its substance, cysts, or, more rarely, circumscribed abscesses, may form in its interior; or the whole tumour may undergo necrosis, and, in exceptional instances, slough away.

Recurrence and dissemination.—Local recurrence is probably the result of some of the tumour-elements having escaped removal, and may take place in the scar, or in the tissues immediately around. Reproduction in the neighbouring lymphatic glands is believed to be due to the tumour-cells becoming arrested in the lymph-sinuses; dissemination in more distant tissues and organs to the tumour-cells being carried by the blood-stream (which they may enter either directly, or indirectly by the lymph-channels) to these parts, where they become lodged and form starting-points for secondary growths. Secondary growths, whether in the glands, or elsewhere, resemble in structure the primary tumour.

Classification.—Tumours are here classified, partly according to their supposed origin, and partly according to their anatomical structure. Thus, they may be divided into:—

I. *Mesoblastic or connective-tissue tumours*, which are such as spring from the connective tissue. These may be subdivided into:—A. Those of the type of fully-formed connective tissue, *i.e.*, fibrous, cartilaginous, fatty, osseous, and mucous tissue: (1) *Fibroma*, (2) *Enchondroma*, (3) *Lipoma*, (4) *Osteoma*, and (5) *Myxoma*. B. Those of the type of the higher complex connective tissues, *i.e.*, muscle, nerve, blood-vessels, lymphatic vessels, lymphatic glands, papillæ and secreting glands: (1) *Myoma*, (2) *Neuroma*, (3) *Angioma*, (4) *Lymphangioma*, (5) *Lymphoma*, (6) *Papilloma*, and (7) *Adenoma*. C. Those of the type of embryonic connective tissue: (1) *Round-celled sarcoma*, (2) *Spindle-celled sarcoma*, (3) *Myeloid sarcoma*.

II. *Epiblastic and hypoblastic tumours*, which are such as are composed of cells like epithelium. They are divided into:—A. Acinous or spheroidal-celled carcinoma: (1) *Hard, scirrhous,* or *chronic carcinoma;* (2) *Soft, encephaloid,* or *acute carcinoma;* and (3) *Colloid carcinoma.* B. Epithelial carcinoma: (1) *Squamous-celled epithelioma,* and (2) *Columnar-celled or cylindrical epithelioma.*

III. *Tumours in which epiblastic, hypoblastic and mesoblastic elements are combined.* A. Teratomata, a rare form of tumour found occasionally in the ovaries and testicle, containing bone, hair, teeth, &c.

I. MESOBLASTIC OR CONNECTIVE-TISSUE TUMOURS.

A. *Tumours of the type of fully-formed connective tissue.*

FIBROMATA OR FIBROUS TUMOURS consist of fibrous tissue, which may vary in density from the firmness of a tendon or ligament to the soft consistency of the subcutaneous tissue. They are quite innocent, grow slowly, do not return if completely removed, and are usually surrounded by a distinct capsule.

Structure.—The firmer varieties consist of dense fibrous tissue, intermixed with but few elastic fibres and connective-tissue corpuscles. The fibres, as a rule, are variously interlaced without definite arrangement, though in some fibromata they form concentric circles around the blood-vessels. On section they appear firm, smooth, and glistening, and of a greyish-white colour. The vessels are usually small, thin-walled, and not numerous, though certain of the fibromata (*naso-pharyngeal polypi*) are very vascular, and are permeated by large cavernous blood-spaces. The *softer varieties,* formerly called fibro-cellular tumours, consist of loose succulent fibrous tissue, and often contain large and numerous blood-vessels. On section they appear yellowish, glistening, semi-transparent, and gelatinous, and a serous fluid can be squeezed out from the cut surface.

Secondary changes.—Calcification, ulceration, and mucoid softening.

Usual seats.—Fibromata may grow from the connective tissue anywhere, but the harder forms are chiefly met with in the periosteum, especially that of the jaws (*fibrous epulis*), in the uterus where they are intermixed with unstriped muscle (*myo-fibroma*), in the neurilemma of nerves (*false neuroma*), on the termination of nerves (*painful subcutaneous tumour*), and in the naso-pharynx and rectum (*fibrous polypus*). The *softer* forms grow from the subcutaneous and submucous tissue, and the intermuscular septa, and are most frequently met with in the scrotum, labium, and scalp. The loose-textured, large and often pendulous growths, occurring in the subcutaneous tissue, and known as *wens*, and the small, sessile, or partially-pedunculated tumours scattered over the body in the condition known as *molluscum fibrosum*, are varieties of soft fibromata.

The *signs* and *diagnosis* of fibromata vary according to their situation, and will be again referred to under the diseases of the various regions in which they occur. The firm fibromata are usually oval or globular, smooth, painless unless attached to a nerve, moveable, very firm and hard, and generally single. The softer forms are smooth, globular, elastic, soft and painless, especially when growing about the scrotum or labium; doughy, non-elastic, moveable, pendulous, and fleshy when occurring as wens.

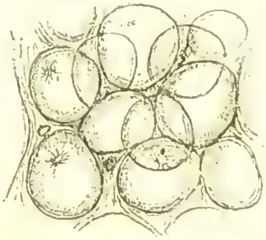

FIG. 7.—Fatty Tumour.

Treatment.—Where practicable they should be removed.

LIPOMATA OR FATTY TUMOURS are composed of fat like that normally found in the body. They are innocent, and grow slowly, but may attain a large size, and do not return on removal. They are most common in adult life.

Structure.—They consist of masses of fat bound together by delicate connective tissue and blood-vessels, and are surrounded as a rule by a thin capsule, which is attached by fibrous septa to the skin. The microscopical characters are seen in Fig. 7.

Secondary changes.—Mucoid softening, inflammation with adhesion from pressure, and, very occasionally, ulceration and calcification.

Usual seats.—They are most common on the shoulders, back, and nates, where they have been attributed to irritation or pressure as by the braces, the sitting posture, &c.

Signs and diagnosis.—They form circumscribed, lobulated, semi-fluctuating, painless, soft, inelastic tumours, generally single, but occasionally multiple. They may be distinguished from a chronic abscess, a bursa or cyst, the swellings for which they are perhaps most likely to be mistaken, by the edge slipping from under the finger when the side of the tumour is pressed upon, by the dimpling of the skin when pinched up between the thumb and fingers, and by the non-escape of fluid on puncture with a grooved needle. They are said sometimes to shift their site by slipping along in the connective tissue. A diffuse variety of lipoma is sometimes met with in the form of symmetrical masses of fat at the back of the neck and below the chin. This variety is mostly seen in stout men above middle age, and especially in those who are addicted to alcohol.

Treatment.—The capsule should be freely opened, when the tumour will usually readily shell out. The diffuse form should be left alone; for such liquor potassæ in small doses for long periods is said to do good.

ENCHONDROMATA, OR CARTILAGINOUS TUMOURS, consist of cartilage, and, when pure, are quite innocent, grow slowly, and do not return on removal. Cartilage, however, is frequently developed in sarcomatous tumours, and it is probable that the malignancy which enchondromata have at times apparently exhibited may have been due to the presence of sarcoma elements which were overlooked.

Structure.—Cartilaginous tumours are generally encapsuled, and, when large, are often lobulated. They may consist of a single mass of cartilage, without visible partitions, or of numerous small clustered masses bound together by connective tissue and blood-vessels. On section they are translucent, bluish-grey, pinkish-white, homogeneous or coarsely granular, and frequently mapped out into irregular lobules. They usually consist of hyaline- or fibro-cartilage. The microscopical characters of typical examples of the hyaline and fibrous varieties are seen in Fig. 8.

Secondary changes.—Calcification, ossification, mucoid softening with formation of cysts, and ulceration.

Usual seats.—(1) The bones, especially the phalanges of the fingers, the lower end of the femur, and the head of the tibia and humerus, and (2) the parotid gland. Enchondromata may also occur in the subcutaneous tissue and the testicle.

The *signs and diagnosis* will be given under *tumours of bone* and the *parotid gland.* Here only need it be said, that their chief characteristics are their extreme hardness, smooth or lobulated surface, and slow growth.

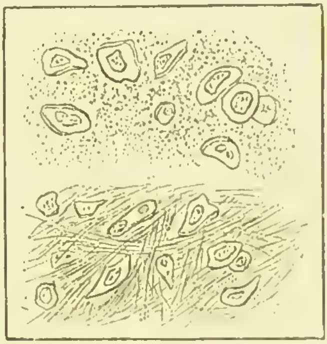

FIG. 8.—Cartilaginous Tumour.

Upper half hyaline; lower half fibrous.

They are usually single, except in the hands, where generally several fingers are affected. At times they are of a softer consistency in places owing to mucoid softening, and at times of rapid growth, but in the latter case it is probable that they contain sarcomatous elements. Although they may occur at any age, they are most common in the young.

Treatment.—They should be removed where possible.

OSTEOMATA OR OSSEOUS GROWTHS consist of true bone. They very rarely occur except in connection with bone or cartilage, and will again be referred to under diseases of bone. Those growing in connective tissue apart from bone are probably other tumours, or structures such as cysts, tendons, and muscles, that have undergone calcification or ossification.

MYXOMATA OR MUCOUS TUMOURS consist of tissue resembling that found in the umbilical cord and vitreous humour of the eye; but many of the growths that were formerly claimed as myxomata would appear to be fibromata, sarcomata, or enchondromata, undergoing mucoid softening. Pure myxomata are innocent tumours, and do not return if completely removed, but they may attain a large size.

Structure.—They consist of a soft gelatinous semi-translucent material, enclosed in a loose capsule of connective tissue, and intersected by bands of fibrous tissue. On section, they are of a pinkish or yellowish-grey colour, and of a soft gelatinous consistency, often almost diffluent; whilst a tenacious and glairy fluid containing large quantities of mucin oozes away from the cut surface. Under the microscope there are seen round and

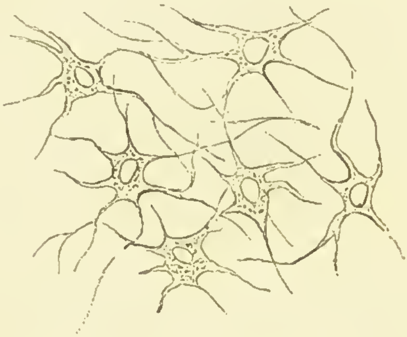

FIG. 9.—Myxomatous Tumour.

spindle cells and stellate cells with branching processes, the processes forming a delicate stroma in the meshes of which the homogeneous, gelatinous basis-substance is contained (Fig. 9). The round and spindle cells vary in number, and are not shown in the diagram. Fibrous tissue, fat, cartilage, and sometimes adenomatous and sarcomatous elements may likewise be present; but it is questionable in these cases whether the tumour should not be regarded as a soft fibroma, lipoma, enchondroma, sarcoma, &c., undergoing mucoid degeneration.

Secondary changes.—Fatty degeneration, inflammation, ulceration, and the formation of blood-cysts owing to rupture of the capillary vessels.

Usual seats.—They are most often found in the nose, where they constitute the gelatinous polypus. They are also found in the adipose, subcutaneous, submucous, and subserous tissue, and occasionally in the periosteum and medulla of bone and neurilemma of nerves.

Signs.—Except when forming polypi, as in the nose, they resemble fatty and soft fibrous tumours, from which they cannot be diagnosed with certainty. The so-called gelatinous or mucous polypus will again be referred to under *Diseases of the Nose.*

Treatment.—Removal where practicable.

B. *Tumours of the type of the higher connective tissues.*

The *myomata* or muscle tumours consisting of non-striated or even of striated muscular fibres; the *neuromata* consisting of true nervous tissue, either the grey or the white; the *angiomata*, or nævi; the *lymphangiomata* consisting of dilated lymphatics, and the *lymphomata* and *lymphadenomata* consisting of lymphatic glandular tissue, will receive no further attention here (see *Nævi*, *Diseases of Nerves and Lymphatics*). Unstriped muscle tissue, it may be said, however, is frequently found in the so-called fibroid tumours (*myo-fibromata*) of the uterus, of which, indeed, it often forms the chief part. It is also found in the chronically enlarged prostate.

PAPILLOMATA or WARTY and VILLOUS TUMOURS resemble in structure the papillæ of the skin and mucous membrane. They include warts, condylomata, and mucous tubercles, and some forms of so-called villous tumours. They are innocent growths, rarely attain a large size, and only occur in the skin and mucous membrane. In old people, however, warty growths are apt to degenerate into epithelioma; and villous growths in the bladder may destroy life by the hæmorrhage to which they frequently give rise.

Structure.—They all agree in that they resemble hypertrophied simple or compound papillæ. Thus, they consist of several layers of connective tissue surrounding one or more central blood-vessels, and are covered by one or many layers of epithelium resembling that natural to the part from which they spring. The epithelium, however, never penetrates the connective tissue—a point that serves to distinguish them pathologically from epithelioma, which in many respects they resemble in structure. The *warts and warty growths*, which form circumscribed tumours or cauliflower-like masses often of considerable size, consist of one or more enlarged papillæ covered with several layers of horny epithelium, and contain as a rule only a few small blood-vessels. The *mucous tubercles* and *condylomata*, which occur as flattened elevations, also consist of enlarged papillæ, but the epithelium covering them is moist and sodden, and the connective tissue, as might be expected from their rapid growth, is abundantly infiltrated with small round cells. They are always the result of syphilis. The *villous tumours*, which form delicate branching growths resembling the villi of the chorion, are also classed by some pathologists as papillomata, even when they grow from parts as the interior of the bladder where no papillæ exist. In such situations they spring from the sub-epithelial connective tissue, and owe their papillary shape to the arrangement of the connective tissue and epithelium around the blood-vessels. The latter are often dilated and numerous, and frequently give way, leading to serious hæmorrhages. The epithelium covering them forms a delicate layer, and may often be rubbed off or washed away by the urine.

Usual seats.—Papillomata in the form of warts and warty growths, are of most frequent occurrence in the skin, especially of the hands and genital organs, and in the larynx. As mucous tubercles and condylomata, they occur about tho anus and genitals, and on the mucous membrane of the mouth and throat. The villous growths are met with in the bladder, rectum, and larynx.

Secondary changes. — Pigmentation, ulceration, and atrophy. As age advances, the epithelium in the case of the warty growths is liable to invade the underlying connective tissue, the papilloma being thus converted into an epithelioma.

The *signs, diagnosis, and treatment* of the different varieties of papillomata are given under the head of skin, syphilis, bladder, rectum, and larynx. All that need be said here is that warty growths, especially in some situations as about the genitals, may greatly resemble epithelioma, from which, however, they may generally be distinguished by the absence of induration at their base, slower growth, non-implication of the glands, the probable history of venereal disease, and by their occurrence usually at an age younger than that at which epithelioma is commonly met with.

ADENOMATA OR GLANDULAR TUMOURS are innocent growths resembling secreting glands in structure, and only grow in connection with pre-existing glandular tissue. They are divided into the *acinous* and *tubular*, according as they resemble one or other of these glands.

The *acinous variety* consists of acini, lined with spheroidal epithelium, and communicating with each other by duct-like channels. The acini are clustered in twos, threes, or more, and are separated and bound together by connective tissue, in which the vessels ramify. Pure adenomata are rare, the scanty amount of intertubular and interacinous connective tissue in such being more often replaced by fibrous tissue (*adeno-fibroma*), or by mucous tissue (*adeno-myxoma*), or by sarcomatous elements (*adeno-sarcoma*), or by a combination of two or more of the above tissues (*adeno-fibro-sarcoma, adeno-myxo-sarcoma*); whilst at times the acini or ducts become dilated into cysts, in which proliferating growths (*intracystic growths*) may project. The tumour is then spoken of as an *adeno-cystoma, cysto-sarcoma*, &c., according to the character of the intertubular and interacinous connective tissue. The microscopical appearance of an adenoma is shown in Fig. 10.

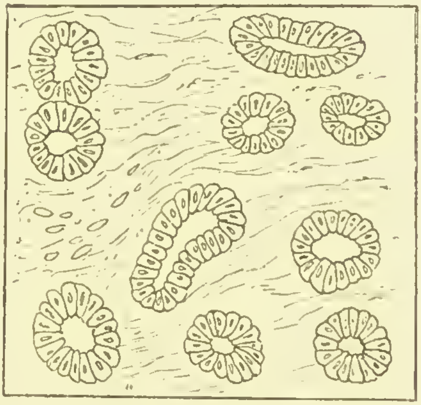

Fig. 10.—Adenomatous Tumour.

The *tubular adenomata* resemble the tubular glands; they are most common in the mucous membrane of the intestine, where they form papillary or polypoid growths.

Both varieties are distinguished from carcinoma, in that the epithelium does not penetrate the basement membrane and invade the connective tissue.

Usual seats.—The acinous occur in the mamma, where they are generally of the adeno-fibromatous form, the lip, the prostate, the thyroid, parotid, and lachrymal glands, and the sebaceous glands of the skin. The tubular occur in the intestine, especially the rectum.

Secondary changes. — Cystic degeneration consequent upon mucoid softening, and fatty degeneration of the epithelium.

Signs, diagnosis, and *treatment.* See Diseases of the Breast, Rectum, &c.

C. *Tumours of the type of embryonic connective tissue.* (*Sarcomata.*)

Sarcomata constitute a group of tumours resembling in structure normal embryonic or immature connective tissue. They include the fibro-nucleated, fibro-plastic, myeloid, and recurrent fibroid tumours, and many of the so-called cancers of the older pathologists. Normal embryonic tissue in the course of development may become fibrous tissue, cartilage, bone, &c. The sarcomata, however, retain the structure of embryonic tissue throughout their life-history; and although in places, and indeed, in some instances in the greater part of the tumour, development may proceed, as in the normal growth of the body, to the formation of fibrous tissue, cartilage, or bone, yet the circumferential or growing parts of the tumour will always be found to consist of sarcoma elements. Hence the importance of examining the growing part lest a sarcoma which has undergone chondrification, ossification, &c., be pronounced a cartilaginous or osseous tumour. The sarcomata present the most diverse characters, both as regards their structure and their clinical behaviour, but have the following in common:—1. The cells of which they are composed consist of masses of protoplasm without distinct cell-wall, and contain one or more nuclei. 2. Each cell is surrounded by a varying amount of intercellular substance which has no definite arrangement, and does not form alveolar spaces as in carcinoma. 3. The blood-vessels have very thin walls, and ramify among the cells, not in the stroma as in carcinoma; indeed, they are often mere spaces bounded by the cells themselves; hence the frequency with which hæmorrhages occur in the substance of the growth. 4. Dissemination usually takes place by the blood-vessels (not by the lymphatics, as in carcinoma), a fact which may probably be explained by the above-mentioned relation of the vessels to the cells. 5. The secondary growths, when dissemination occurs, are, as a rule, like the primary, and are most frequent in the lungs. 6. Sarcomata grow by invading the surrounding tissue, and generally return locally after removal, probably because some portion of infiltrated tissue has been left. 7. They do not, as a rule, affect the lymphatic glands, except when they occur as primary tumours in such glands, or when they grow, as pointed out by Mr. Butlin, in the testis and tonsil, when implication of the glands is the rule rather than the exception. 8. They are of most frequent occurrence in youth and early middle life. 9. Their cut section, when fresh, does not yield a milky juice like that obtained on scraping a carcinoma.

In their simplest form sarcomata consist of small round cells resembling leucocytes, embedded in a very scanty amount of homogeneous intercellular substance traversed by delicate loops of capillary vessels; in fact they so closely resemble the granulation tissue of inflammation as to be microscopically indistinguishable from it. In the higher forms the cells become elongated and of a spindle shape, and the intercellular substance may show an attempt at fibrillation; or fibrification, chondrification or ossification may ensue, and indeed in some instances may proceed to such an extent that the whole tumour appears composed of fibrous tissue, cartilage or bone, and it may only be at the growing edge that the sarcomatous elements are discoverable. Notwithstanding such changes the tumour will continue to display its malignancy in that it still invades the surrounding tissues, or becomes disseminated through internal organs. Sarcomata that have thus undergone ossification, are often spoken of as *ossifying sarcomata*. Ossification, however, is seldom met with except in sarcomas in connection with bone, and although it may then occur in all varieties, is most common in the spindle-celled and mixed forms. The new bone spicula usually grow into the tumour at right angles to the shaft of the bone, and are surrounded by sarcoma tissue; whereas in the true osteomata the bone spicula are parallel to the shaft, and are surrounded by cartilage or periosteum.

Sarcomata may be divided into four chief groups (*a*) the *round-celled*, (*b*) the *spindle-celled*, (*c*) the *giant-celled* or *myeloid* and (*d*) the *mixed-celled*.

(*a*.) The ROUND-CELLED SARCOMATA usually occur as soft, vascular, and very rapidly growing tumours, and often attain a large size, and quickly become disseminated through distant parts of the body and through internal organs.

Structure.—They consist of round cells like leucocytes, varying in size in different tumours, and embedded in a small amount of granular or homogeneous intercellular substance. On section they appear soft and vascular, resembling brain matter. Hence the term *encephaloid* or *medullary* which is sometimes applied to them. It was this variety of sarcoma that was formerly called *encephaloid cancer*. The microscopical appearance of a typical specimen is shown in Fig. 11.

Secondary changes.—They may undergo mucoid softening, fatty degeneration, and ulceration, or blood may be extravasated in their substance leading to the formation of cysts (*sarcomatous blood-cysts.*)

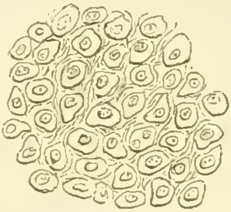

Fig. 11.—Round-celled Sarcoma.

Usual seats.—Wherever fibrous tissue exists; but they are most common in the periosteum, bone, skin, subcutaneous tissue and testicle.

Varieties of round-celled sarcoma.—1. The *glio-sarcoma*, which grows in the connective tissue of nerves, and has a matrix like that of the neuroglia of nerve centres. It occurs most frequently in the retina and brain. 2. The *lympho-sarcoma*, which grows in the lymphatic glands. It consists of a reticulum resembling lymphoid tissue, and the sarcoma cells are usually of the size of leucocytes. 3. The *psammoma*, a very rare form which occurs only in the pineal body and orbit. 4. The *alveolar sarcoma*, in which the matrix forms a net-work enclosing each cell in a separate space or alveolus. 5. The *melanotic sarcoma*, which contains pigment both in the cells and intercellular substance. Its favourite seat is in the skin and the choroid coat of the eye, *i.e.*, in situations where pigment normally exists. It becomes rapidly disseminated through the body, the secondary growths being generally also pigmented. It is the most malignant of the sarcomas, and was formerly known as *melanotic cancer*. The cells are sometimes spindle-shaped instead of round. It differs from the pigmented wart, in that the latter is firm, often pedunculated or lobulated, and of slow growth.

The signs of round-celled sarcomata vary so much according to the tissue implicated, that only the briefest outline of their general course can be here given. They will more especially be referred to under bone, testicle, and breast. Here it may suffice to say that they exhibit all the signs of malignancy. Thus they grow rapidly, invade the surrounding tissues, the veins over them become enlarged, and the skin as they approach it becomes inflamed and finally gives way, and an ulcerating chasm is left or a fungus protrudes. The health and strength fail, cachexia sets in, evidence of dissemination of the disease in other tissues or in internal organs may be manifested, and death soon ensues.

Diagnosis.—It is often very difficult to diagnose a sarcoma, especially of bone, from inflammatory affections. The history of the case, the unequal consistency of the tumour, which may be hard in places, soft in others, the irregularity of its shape, the absence of pus on puncture with a grooved needle, and the progressive loss of weight and strength point to its sarcomatous nature; but an incision into it will sometimes be necessary to clear up the doubt. The rapid growth and dark colour of a melanotic sarcoma are distinctive.

Treatment.—The only effectual treatment is removal. When the tumour is situated in one of the extremities amputation well above the disease should be practised; when on the trunk it should, where practicable, be dissected out, cutting as wide of the disease as possible.

(*b.*) THE SPINDLE-CELLED (Fig. 12) are the most common of the sarcomata, and are composed of spindle-shaped cells, varying in size, and containing one or more nuclei. The cells, in some instances, are arranged concentrically around the blood-vessels, or in bands; or again, in other instances, appear to have no definite arrangement. Spindle-celled sarcomata are subdivided according to the size of their cells into the large-and small-spindle-celled varieties.

The small-spindle-celled sarcomata are firmer and less rapid in their growth than the round-celled or large-spindle-celled forms; they do not become so quickly disseminated in internal organs, and are therefore less malignant. They generally recur locally when removed; but after many recurrences, their tendency to return may at length cease, or they may, on the other hand, assume a more malignant form and become disseminated. *Structure.*—They consist of small spindle cells containing usually a single nucleus; the cells are embedded in a small amount of homogeneous intercellular substance, which at times is somewhat fibrillated. They may at first be enclosed by a capsule, but later infiltrate the surrounding parts. They appear as smooth firmish growths, pinkish-white, semi-translucent, and fibrillated on section. Their microscopical appearance is seen in Fig. 12. *Secondary changes.*—Fibrification, chondrification, calcification, ossification, and, when implicating the skin, ulceration. *Usual seats.*—Periosteum, fasciæ, and subcutaneous tissue.

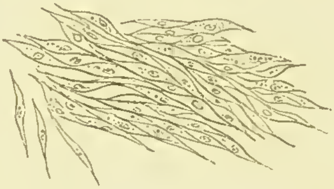

FIG. 12.—Spindle-celled Sarcoma.

The large-spindle-celled sarcomata are much softer than the preceding variety, and often grow rapidly, and quickly become disseminated; indeed, they may be as malignant as the round-celled growths. *Structure.*—They consist of large spindle cells, which frequently contain several oval nuclei, embedded in a scanty amount of intercellular substance. They occur as non-encapsuled tumours of soft consistency, frequently in parts diffluent, and on section appear of a pinkish-white colour, and often blotched with blood. *Secondary changes.*—Fatty degeneration, blood-extravasation with the formation of blood-cysts, and ulceration. *Usual seats.*—The intermuscular fasciæ, periosteum, and breast.

Signs and diagnosis.—The small-spindle-celled sarcomata, when occurring in the fasciæ and subcutaneous tissue, appear as moderately firm, or at times as softer growths, unattended by signs of inflammation unless involving the skin. They recur *in situ* after removal, but do not as a rule become disseminated. The large-spindle-celled forms resemble the round-celled, from which they cannot be distinguished before removal. Both varieties are more especially referred to under *Diseases of Bone.*

Treatment.—The small-spindle-celled variety should, where practicable, be freely and widely removed. The treatment of the large-spindle-celled is like that of the round-celled.

(*c.*) The GIANT-CELLED or MYELOID SARCOMATA nearly always occur in connection with bone, and will be more fully described in the section on *Diseases of Bone.* They are usually of slow growth, and are amongst the least malignant of the sarcomata, especially when occurring in the interior of bone. After removal, however, they have been followed by the more malignant forms.

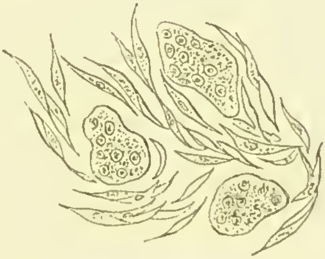

FIG. 13.—Myeloid Sarcoma.

Structure.—They consist of spindle or round cells, amongst which are found large irregularly-shaped masses of protoplasm, containing often as many as thirty or forty oval, highly-refracting, distinct nuclei.

These masses of nucleated protoplasm are known as *giant or myeloid* cells, and resemble those found in the marrow of the fœtus. The microscopic appearance is seen in Fig. 13. Myeloid sarcomata vary from a firm or fleshy to a soft or jelly-like consistency, and are neither elastic nor tough. On section they appear uniformly smooth, succulent, shining, semi-translucent, but not fibrillated, of a livid crimson or maroon colour not unlike the muscular tissue of the mammalian heart, and often blotched with brighter patches of pink or darker red due to blood-extravasation.

Secondary changes.—Chondrification sometimes occurs, but ossification is rare. Blood-cysts are very common, from the giving way of some of the numerous thin-walled vessels.

Usual seats.—In the interior of the ends of the long bones, especially the lower end of the femur and upper end of the tibia, and in the lower jaw; less rarely they grow from the periosteum.

Signs, diagnosis, and treatment.—See Sarcoma of Bone.

(*d.*) The MIXED-CELLED.—Many sarcomatous tumours consist of both spindle and round cells. They may resemble either the spindle- or the round-celled tumours, and cannot be distinguished without a microscopical examination.

Sarcomatous blood-cysts.—Soft sarcomatous tumours sometimes become completely broken down by extravasation of blood into their substance, and converted into cysts containing partly fluid and partly coagulated blood. When such a cyst is punctured, the hæmorrhage is often difficult to control. When cut into, the walls are generally found ill-defined, and it may be impossible to distinguish the cyst from a hæmatoma or ordinary blood-cyst, without a microscopical examination of a piece of the wall.

II. EPIBLASTIC AND HYPOBLASTIC TUMOURS.

Tumours of the type of epithelial tissues (*Carcinoma*).

CARCINOMATA, or CANCERS, are malignant growths consisting of epithelial-like cells contained in an alveolar stroma. The individual cells are not surrounded by any intercellular substance as in the sarcomata, and the vessels run in the stroma, and not among the cells. They are derived from pre-existing epithelium, and are hence spoken of as tumours of epiblastic or hypoblastic origin. The epithelium is believed to proliferate and break through the wall of an acinus or duct, or the basement membrane of the skin or mucous membrane, and invade the surrounding or underlying connective tissue, where it is supposed to enter the lymphatic spaces, and thence, sooner or later, pass into the lymphatic vessels, and so finally become disseminated. The cells in carcinoma, though varying in their character, retain the type of the epithelium from which they spring. Thus, they are more or less squamous when derived from the skin, squamous or columnar when derived from a mucous membrane, spheroidal when derived from a gland. The alveoli in which the cells are contained are by many regarded as the lymphatic spaces natural to the affected tissue dilated by the invading epithelium. They communicate with one another, forming a kind of cavernous tissue throughout the growth. The stroma surrounding the alveolar spaces at first consists of the connective or other tissue of the invaded parts, infiltrated more or less with small round cells. This small-cell infiltration is ascribed to the irritation of the epithelial invasion, and from it is believed to be later derived the fibrous tissue constituting the dense stroma of some forms of carcinoma.

The blood-vessels, which run in the stroma, are numerous in the more rapidly-growing tumours, and especially in the circumferential parts, but are much fewer in number in the more chronic forms, and in the central parts of the latter may be obliterated by the growth of the fibrous tissue. Hence the frequency with which fatty degeneration of the cells, and breaking down (*ulceration*) of the older parts of the tumour occur. In the softer or rapidly-growing forms, in which the stroma is scanty and the support that the vessels receive from it consequently but slight, hæmorrhages are frequent. Carcinomata have no capsule, grow by endogenous cell-division and continued invasion of the surrounding tissues, and, sooner or later, break down and ulcerate. They implicate the nearest lymphatic glands, and finally become disseminated. At first the general health is usually but little affected; but later, partly owing to the local ulceration and partly to the dissemination of the growth, a condition known as cancerous cachexia sets in, the skin becoming sallow and of a peculiar earthy colour, the face careworn and anxious, and the body emaciated. The strength fails, and the patient at length dies of exhaustion induced by the general interference with nutrition, local ulceration, hæmorrhages, pain and mental anxiety.

VARIETIES OF CARCINOMA.—The carcinomata are divided into two great classes:—(1) *The acinous* or *spheroidal-celled;* and (2) *the epithelial.* The acinous, or spheroidal-celled, are further divided into (*a*) *the hard spheroidal-celled*, (*b*) *the soft spheroidal-celled*, and (*c*) *the* *colloid* variety, which is probably a degenerated condition of one or other of the former. 2. The epithelial are sub-divided into (*a*) the *squamous-celled*, and (*b*) the *columnar-celled epitheliomata.*

1. THE ACINOUS OR SPHEROIDAL-CELLED CARCINOMATA consist of epithelial cells resembling spheroidal or glandular epithelium, and only grow in connection with glands. They usually exhibit the characteristic alveolar structure of the carcinomata in a well-marked degree. They are divided into the hard spheroidal-celled, the soft spheroidal-celled, and the colloid varieties.

(*a.*) *The hard spheroidal-celled carcinomata, the scirrhous or chronic cancers* are moderate-sized, hard, nodular, and comparatively slowly-growing tumours, which, sooner or later, ulcerate and become disseminated through the body.

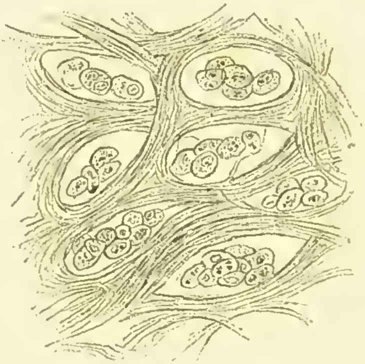

FIG. 14.—Acinous carcinoma (hard spheroidal-celled or scirrhous variety).

Structure.—They are characterized by the large amount of their stroma (Fig. 14). Indeed, the central parts of the growth, in some cases, consist of little else than dense fibrous tissue, with a few atrophied and fatty-looking cells in the shrunken alveoli. The circumferential parts of such tumours, however, still display the typical characters of acinous carcinoma, and in the surrounding tissues, the epithelial invasion and the small cell infiltration are still going on. It is owing to the excessive formation of fibrous tissue that the scirrhous cancer is so hard, and creaks under the knife when cut; and to the tendency of the fibrous tissue to shrink, that the skin over the tumour becomes puckered, and the nipple in the case of the mamma retracted, and that the cut surface of the tumour becomes concave.

Usual seats.—The breast; but scirrhous cancer also occurs in the œsophagus, pylorus, and, more rarely, in other situations. The general appearance of scirrhous cancer, the symptoms, diagnosis, and treatment, are given under Diseases of the Breast, its favourite seat.

(*b.*) *The soft spheroidal-celled carcinomata, the medullary, encephaloid or acute cancers,* are much more rapid in their growth than the preceding variety, and form soft and often large tumours, quickly terminating in ulceration and general dissemination through the body. *Structure.*—The stroma is scanty in amount (Fig. 15), and does not contract like that of scirrhus; the cells, which are very prone to undergo fatty degeneration, are contained in large alveoli. They are very vascular, and as the scanty stroma affords but little support to the vessels, extensive hæmorrhages into the substance of the growth are common. On section, they appear of a greyish-white or cream-colour, blotched in places with blood, whilst in the centre they may be almost diffluent, consequent upon their having undergone fatty degeneration. On account of the resemblance to brain-matter the older pathologists termed them *encephaloid cancers.* After they have involved the skin, they protrude in the form of a bleeding fungating mass, and hence were further called *fungus hæmatodes.* Although in accordance with general usage, the spheroidal-celled carcinomata are divided into hard and

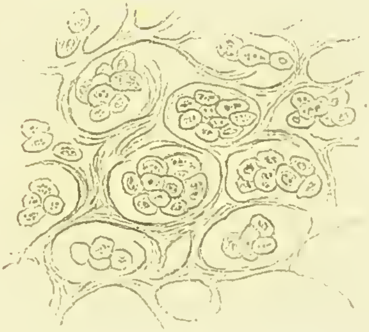

FIG. 15.—Acinous carcinoma (soft spheroidal-celled or medullary variety).

soft, it should be understood that no hard and fast line can be drawn between them, as the characters of the one often merge into those of the other, so that sometimes it may be difficult to decide whether an individual spheroidal-celled carcinoma should be classed as hard or soft.

Usual seats.—The testis, liver, bladder, kidney, ovary, and mamma. Secondary growths in internal organs consequent upon the dissemination of scirrhous cancer are often of the soft variety.

(*c.*) *Colloid, gelatiniform, or alveolar carcinomata.*—These terms are applied to either of the above described varieties when they have undergone mucoid or colloid degeneration. It is believed that the degeneration generally begins in the cells which, as they become enlarged, so distend the alveoli that the latter can be seen by the naked eye. The colloid material is glistening, semi-translucent, and jelly-like or in places diffluent. In it some spheroidal cells are generally found. *The favourite seats* of these cancers are the stomach, intestine, omentum and ovary; but they occasionally occur in the breast.

2. EPITHELIAL CARCINOMATA always spring from the skin or a mucous membrane, and constitute the second great division of the cancers. They are characterized by the resemblance of their cells to squamous or to columnar epithelium. The typical alveolar arrangement of the carcinomata is much less well marked than in the acinous form. They are divided into the *squamous-celled* and the *columnar-celled epitheliomata.*

(*a.*) *Squamous-celled epithelioma.*—It was to this form of carcinoma that the term epithelioma was originally applied; but as all carcinomas are now believed to be epithelial growths, the term squamous-celled is prefixed to this variety to distinguish it from the columnar-celled and the spheroidal-celled carcinomata. Squamous-celled epitheliomata may spring either from the skin or from any mucous membrane covered with squamous epithelium, and are especially common where skin and mucous membrane meet, as in the lip, anus, &c. They are most frequent in the old, seldom occurring under forty years of age, and are more common in men than in women. They are usually the result of continued irritation; thus in the tongue they may be due to the presence of a jagged tooth, in the lip to the constant contact of a hot pipe stem, in the scrotum to the retention of soot or coal-tar in the folds of the skin. They are also not uncommon in situations where the epithelium is in an abnormal condition, as in old scars, white patches on the tongue and inside of the cheek, chronic ulcers, warts, and moles.

Structure.—Squamous-celled epitheliomata consist of columns of epithelium, which have grown into the connective or other underlying tissue, surrounded by an imperfectly fibrillated stroma, or by a small cell-infiltration. At the same time the epithelium is usually also proliferated outwards, forming a warty excrescence or cauliflower-like growth. Breaking down rapidly ensues, and an epitheliomatous ulcer is the result. Amongst the cells forming the columns of invading epithelium are found in places small collections of cells of a crescentic shape, arranged concentrically around one or more central rounded cells. These collections, spoken of as *cell-nests*, are probably due to the more rapid growth of the epithelium at certain spots, the shape and arrangement of the peripheral layers of cells being due to their compression between the rapidly-growing central cells and the surrounding tissues.

In the accompanying wood-cut (Fig. 16) the downgrowing epithelial columns, a column in transverse section, and several cell-nests are seen.

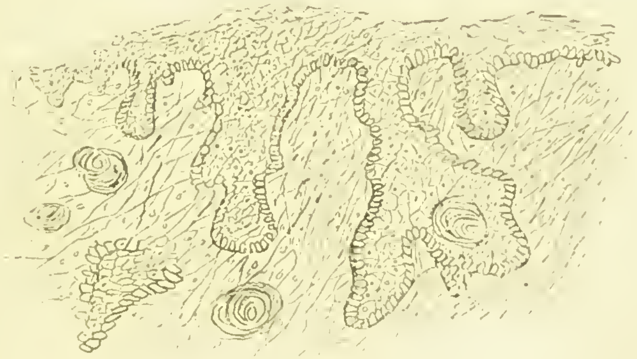

FIG. 16.—Squamous-celled epithelioma.

Usual seats.—Tongue, lower lip, cheeks, gums, vulva, scrotum, penis and anus.

Signs.—A squamous-celled epithelioma usually begins as a warty tubercle or fissure, which soon becomes an ulcer with everted, sinuous and indurated edges, and a hard, warty, and irregular base, whilst the tissues around become infiltrated with the growth and the nearest lymphatic glands enlarged. Unless an epithelioma is removed whilst the disease is still local, recurrence usually takes place in the nearest lymphatic glands; at times, like other forms of cancer, though less often, it may become disseminated through internal organs. When incompletely removed it will return in the scar. Death is usually the result of exhaustion consequent upon ulceration and hæmorrhage. The *signs*, *diagnosis*, and *treatment* are further referred to under Diseases of Regions. (See *Lip*, *Tongue*, *&c.*)

(*b.*) *Columnar-celled epitheliomata*, *cylindrical carcinomata* or *adenoid cancers* consist of cells derived from columnar or cylindrical epithelium, and are less common and usually of slower growth than the former variety. They begin as papillary outgrowths from the surface of mucous membranes covered with columnar epithelium, or from the interior of the mucous glands, and are most common in the rectum, though they may affect other parts of the intestine, the uterus, &c.

Structure.—They consist of tubes lined with columnar epithelium, and bound together by a delicate connective tissue stroma more or less infiltrated with small round cells. The epithelial cells retain more or less their shape, and are arranged at right angles to the walls of the alveoli, generally leaving a central space. In the more rapidly growing tumours, however, the alveoli become completely filled with the cells. There are no cell-nests as in squamous epithelioma. Like other carcinomata they infiltrate the surrounding tissues, and may affect the lymphatic glands, and later become disseminated in internal organs, especially the liver. Death, however, usually occurs from obstruction of the bowel, hæmorrhage from the ulcerating surface, or exhaustion, rather than from dissemination. Their appearance, symptoms, diagnosis and treatment are further described under *Rectum*.

THE TREATMENT OF CARCINOMA GENERALLY may be divided into the palliative and the radical. The *palliative* is resorted to when from some cause a cancer cannot be removed by operation, and consists briefly in soothing pain by opium, neutralizing the offensive smell when ulceration has occurred by antiseptics, and supporting the strength by nourishing diet and stimulants. The *radical* treatment aims at removing the cancer by operation, in the hope that it may not return or manifest itself in other parts. If removed early, there is a good chance of the squamous epithelioma not doing so, and in some forms of the columnar and acinous carcinoma the same fortunate result has occasionally occurred. As a rule, however, the issue is not so favourable, and after an immunity, varying in duration according to the variety, situation, and size of the tumour, the length of time it has existed, and the implication or non-implication of the lymphatic glands, the disease returns in the scar, in the lymphatic glands, or in internal organs. But though the patient may not be cured by an operation, he may be greatly relieved by the removal of the local trouble, and die with less distress from the implication of internal organs. Should removal be determined on, it is best done by the knife; but in certain parts the scissors or écraseur may be more applicable. At times caustics may be employed. The various methods of removing carcinoma will be described more in detail under Diseases of Regions.

CYSTS.

A *cyst* is a closed sac containing fluid or pultaceous matter. Cysts may be divided into :—

I. *Cysts formed by distension of naturally existing cavities or spaces.*

II. *Cysts of new formation.*

III. *Cysts of congenital origin.*

I. *Cysts formed by distension of naturally existing cavities or spaces.*

These are sub-divided into :—A. Exudation cysts; B. Retention cysts; and C. Extravasation cysts.

A. EXUDATION CYSTS are formed by exudation or by excessive secretion into cavities which have no excretory duct. Under this head are included Bursæ, Ganglia, Cystic bronchoceles, and Cysts in the broad ligament due to the dilatation of Graafian follicles. They will be further referred to under Diseases of Bursæ, Ganglia, &c.

B. RETENTION CYSTS are formed by the retention of the normal secretion and the consequent dilatation of the ducts or acini of the affected gland. They are lined with epithelium; their walls become thickened by fibroid changes; and the natural secretion is altered by inspissation or by exudation from the cyst-wall. Three forms are described—1, atheromatous or sebaceous cysts, due to the dilatation of the sebaceous glands; 2, mucous cysts formed by the dilatation of mucous glands; and 3, cysts produced by the distention of special ducts, as the salivary, lacteal, hepatic, and renal ducts, and tubules of the testicle.

(1.) *Atheromatous* or *sebaceous* cysts occur mostly on the scalp or face, but may be met with on any part of the body, and are often multiple. They do not contain hair-follicles, papillæ, or other skin elements, thereby differing from the dermoid cysts which they otherwise resemble. Those on the scalp are sometimes hereditary. *Signs.*—They form smooth lens-shaped, semi-fluctuating, moveable swellings, often adherent to the skin. They may be distinguished from a fatty tumour by not slipping from under the finger on pressing the edge of the swelling, and from an abcess by the absence of signs of inflammation. A small black punctum, the obstructed orifice of the sebaceous follicle, may moreover, be discovered on the surface. *Secondary changes.*—1. They may become inflamed and break down into an abscess. 2. One part may give way, and the sebaceous matter exude, become hardened, and be pushed up from below, and take the form of a horny growth. 3. Granulations may spring up from the interior of the cyst, and exude as a fungating mass resembling an epithelioma. 4. They may degenerate into an epithelioma. 5. Their walls may undergo calcification. *Treatment.*—They may be removed by—1. Dissection. 2. Splitting them, squeezing out the sebaceous matter, and seizing the cyst-wall with forceps and pulling it out. Care should be taken not to leave any of the wall behind, or a troublesome sinus will remain. 3. Dilating the orifice with a probe, and squeezing out the contents. They are apt, however, to refill when emptied in this way, unless the cyst-wall is also squeezed out or sufficient inflammation is set up to destroy it.

(2.) *Mucous cysts* are formed by the dilatation of mucous glands. They occur in the lips, mouth, labia, and other situations where mucous glands exist. In the mouth they constitute one form of *ranula*. The so-called dropsy of the antrum is generally believed to be due to the dilatation of one of the mucous glands of the lining membrane of that cavity, and the cysts met with at the entrance of the vagina to a dilatation of Naboth's or Bartholin's glands. The walls of mucous cysts are thinner than those of the sebaceous variety; the contents are viscid, and mucoid in character, and cholesterine is at times present. *Treatment.*—Excision of a piece of the wall, and touching the interior with nitrate of silver or other caustic will generally cure them; if not the cyst must be dissected out.

(3.) *Cysts formed by the dilatation of special ducts.*—As examples of these may be mentioned, dilatation of Wharton's duct (*ranula*), of a lacteal duct (*galactocele*), and of a tubule of the testicle (*encysted hydrocele*). For a further account, see Diseases of Regions.

C. EXTRAVASATION CYSTS are formed by extravasation of blood into closed cavities, as the tunica vaginalis of the testicle (*hæmatocele*), &c.

II. *Cysts of New Formation.*

These are divided into—A. Serous cysts; B. Blood-cysts; C. Proliferous compound cysts; and D. Parasitic cysts.

A. SEROUS OR SIMPLE CYSTS are thin-walled cysts, lined with a single layer of endothelium, and containing a sticky serous fluid. They are supposed to be formed by the accumulation of fluid consequent upon irritation, pressure, &c., in the lymphatic spaces of the connective tissue, these spaces subsequently becoming fused into a single cavity. Their walls consist of fibrous tissue formed by the condensation of the surrounding connective tissue by the pressure of the fluid. As examples of serous cysts may be mentioned:—adventitious bursæ developed over prominences of bone, some forms of ganglion, and simple cysts in the breast, neck, &c. By some pathologists, however, the serous cysts found in the neck are regarded as congenital formations. Those in the median line are undoubtedly formed by the enlargement of pre-existing bursæ, *e.g.*, those about the hyoid bone.

B. BLOOD-CYSTS OR HÆMATOMATA may be subdivided into—1. True blood-cysts, which are most commonly met with in the neck, and consist of thin-walled cysts containing pure blood. Their mode of origin is doubtful, but they appear to have some communication with the veins, since if tapped they often bleed very freely. 2. Cysts formed by condensation of the tissues around a mass of extravasated blood. In such the blood may become absorbed or organized; or it may break down and disintegrate, or deposit fibrin upon the wall of the cyst; or suppuration may occur and an abscess ensue. They are common in the scalp and on the ear (*hæmatoma auris*) but may occur in any situation after injury.

The extravasation of blood into serous cavities and into solid tumours is also by some included under Hæmatoma; but such a classification is misleading (see *Hæmatocele*, *Sarcoma*).

C. PROLIFEROUS COMPOUND CYSTS are cysts containing growths. They are most common in the breast and ovary, and will be found more fully described under Diseases of the Breast. These cysts are developed in connection with the growth of solid tumours, and must be distinguished from cystic degeneration, which, as has already been shown, is very common in some forms of tumour. In the one case, the cysts which may be regarded as primary, contain growths springing from their walls or projecting into them from the growth around. In the other case, the cysts are secondary, and are produced by the degeneration and softening of the tumour-elements, or by the extravasation of blood into the substance of the tumour.

D. PARASITIC CYSTS are such as are formed in the tissues around a parasite. As an example may be mentioned the *Hydatid cyst*, for an account of which, as of other parasitic cysts, the student is referred to a work on Medicine.

III. *Cysts of Congenital Origin.*

CONGENITAL CYSTS may be formed in various ways:—1. By the inclusion of a portion of epiblast within the mesoblast (*dermoid cysts*). 2. By the distension in after life of some fœtal structure which has not become obliterated in the course of normal development, for example encysted hydrocele of the spermatic cord developed in an unobliterated portion of the funicular process of the tunica vaginalis, and certain broad ligament cysts developed from the parovarian. (See *Testicle*, *&c.*) 3. By the inclusion of a blighted ovum in a part of the embryo. Such at least is the origin ascribed to certain cysts containing pieces of bone, cartilage, teeth, &c., occasionally found in connection with the ovary and testicle.

Another form of congenital cyst, known as the cystic hygroma, has not at present been satisfactorily explained.

Of the congenital cysts, *Dermoid cysts* only can be described here.

DERMOID CYSTS are cysts in the wall of which are found all the structures constituting the true skin and its appendages, such as hair, hair-follicles, sebaceous-glands, &c. The contents, which resemble sebaceous matter, consist of the secretion of the glands in the cyst-wall, and of epithelial *débris*, and frequently of hair. They are often quite unconnected with the skin, and their origin is attributed to the inclusion of a portion of the epiblast in the mesoblast, an explanation which in the region of the neck and face is probably correct, as these cysts are usually formed about the outer angle of the orbit, and in other of the situations at which in the embryo a cleft or fissure exists between the processes from which the face and neck are developed. In some dermoid cysts of the ovary teeth also are sometimes found. The origin of these, as of the dermoid cysts of the testicle, are not so obvious.

Signs.—The dermoid cyst so common near the outer angle of the orbit, forms a smooth, tense, globular tumour, generally freely moveable on the parts beneath. It is always congenital, grows slowly, and though generally small may attain a considerable size. It should be dissected out by an incision through and parallel to the eyebrow, in order that the scar may be as much as possible hidden. At times these cysts send processes beneath the eyelid, or into the orbit, and they have even been known to perforate the bone and extend into the interior of the skull.

SECTION II.

General Pathology of Injuries.

WOUNDS.

Wounds are divided into two great classes, the *open*, and the *subcutaneous*.

Open wounds.—A wound has been defined as "a solution of continuity in any part of the body, suddenly made by anything that cuts or tears, with division of the skin." Here our attention will be confined to the general pathology and treatment of wounds of the soft tissues. Wounds of special tissues, as bone, muscle, blood-vessels, nerves, &c., will be further referred to under those heads.

The process of repair in open wounds of the soft tissues differs according as the wound is incised, lacerated, contused, or punctured, and according as it is, or is not, kept aseptic, properly drained, and protected from infective processes. The healing process will, moreover, be influenced by the patient's state of health previous to the wound, and the hygienic conditions under which he is subsequently placed. Let us first take a *general view of the process of repair* as it occurs in a simple incised wound in a healthy subject. Immediately the wound is inflicted there will be free hæmorrhage varying in amount according to the vascularity of the part, probably a spouting of blood in jets from a few larger arteries, and a more or less general oozing from the smaller vessels and capillaries. The hæmorrhage from the larger arteries having been arrested, and that from the smaller having ceased spontaneously, the wound, if properly drained, accurately closed, and kept aseptic and at rest, will unite without suppuration by a process of *simple or adhesive inflammation*. Thus, the edges of the wound for the first day or two may present a very faint blush of redness extending for a few lines to perhaps in a large wound half an inch or so beyond the incision; whilst they may be slightly swelled, a little hotter than natural, and tender on pressure, but quite devoid of pain. The redness, swelling and heat, however, may be so slight as to be almost imperceptible, or indeed may be said in some instances not to occur. If an attempt were now made to draw the edges apart they would be found adherent to each other, and a few days later firmly united. All trace of redness and swelling about the edges will by this time have disappeared, a red streak only remaining to mark the line of the wound. This streak grows paler and paler, till ultimately a thin white line, which in course of time may become hardly perceptible, alone indicates the site of the injury. The above-mentioned process, which should be attended by little or no constitutional disturbance, is known as healing by the *first intention*, and is the one which, other things being equal, is always aimed at by the surgeon in the treatment of wounds. Should, however, the wound not admit of its surfaces being placed wholly in contact, or should it be improperly drained and not kept aseptic, the inflammatory redness and swelling of the edges, instead of subsiding and disappearing in a few days, will increase and extend for some distance around; the parts then become tense, there may be throbbing pain, union fails, and suppuration is set up. In the meantime the patient may have a chill or even a distinct rigor, the temperature rises, the pulse is increased in frequency, the tongue becomes coated, the skin hot and dry, the urine scanty and high coloured, the bowels confined, he complains of headache and loss of appetite, and there may be restlessness and want of sleep and perhaps slight delirium (*septic traumatic fever*). If now a free exit is established for the pus, and further septic changes are prevented, the constitutional disturbance subsides, and the surface of the wound becomes covered with granulations. The granulations gradually fill up the wound, and when the level of the skin or mucous membrane is reached, epithelium slowly spreads from the edges of the wound over the granulations till they are completely covered in. A red scar is thus left at the seat of the former wound, and though this in the progress of time assumes a white colour, and becomes smaller from the contraction of the fibrous tissue into which the granulations are at length converted, it is of a permanent character. The above method of repair is known as healing by the *second intention*, or by granulation.

In wounds where there is loss of substance, healing by the second intention is the normal method of union. The surface after the hæmorrhage has been stopped becomes glazed over, and a reddish serum slowly escapes; granulations appear, first here and there, and finally over the whole surface of the wound, which is then gradually filled up as described above. In lacerated wounds the same process occurs, the dead portions of the lacerated tissues, however, being first thrown off in the form of sloughs.

In flap wounds where adhesion by the first intention has failed, after the surfaces of the flaps have become covered by granulations the two layers of granulations in contact may unite, a mode of healing known as *secondary adhesion* or union by the *third intention.* Yet again, when a wound has been sealed by blood or discharges, it may unite either by adhesive inflammation or by granulation, the process being hidden by the scab of hardened blood and discharges, on the separation of which the wound is found soundly healed. It is the common method of healing among animals, and is known as *healing under a scab*, or as it was humorously described by Sir James Paget in his lectures on Surgery, as union by no intention at all.

Thus a wound may heal, 1, by adhesive inflammation, or by the first intention ; 2, by granulation, or by the second intention ; 3, by secondary adhesion, union of granulations, or by the third intention ; and 4, under a scab. These methods of healing may now be studied more in detail.

1. *Healing by the first intention, or by adhesive inflammation.*—Chiefly as the result of the injury inflicted on the tissues by the instrument making the wound, and to a less extent as the result of exposure to the cold air and it may be of the irritation of strong chemical antiseptics, a simple traumatic inflammation is set up in the layer of tissue bounding the incision (Fig. 17 and Fig. 18). As a consequence, stasis and coagulation of the blood is induced in the divided smaller vessels and capillaries, and thus the hæmorrhage from them spontaneously ceases (Fig. 18 A). Immediately around there is dilatation of the vessels with retarded flow, and escape of leucocytes and liquor sanguinis. These infiltrate the tissues adjacent to the incision and pass through the cut lymph-spaces on to the raw surface of the wound. There coagulation occurs, the fibrin and the entangled corpuscles forming a layer of

coagulable lymph between the surfaces of the wound, whilst the serum, at first red from the presence of red corpuscles, but subsequently becoming colourless, drains gradually away. It is this coaguable lymph which causes the surfaces of the wound after the first few hours to adhere, or to become glazed if the wound is kept open for some time before the edges are approximated as was formerly a not uncommon practice. A little further from the line of incision there is the usual inflammatory phenomenon of dilated vessels with accelerated flow (Fig. 18 B), thus accounting for the faint blush of redness and the slight swelling about the edges of the wound. The coagulable lymph uniting the surfaces of the wound, together with the tissues immediately adjacent to the incision, next

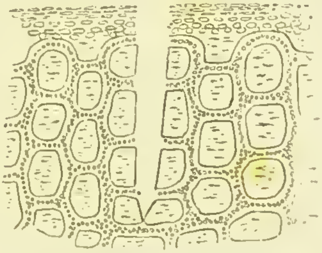

FIG. 17.—Diagram representing a simple incised wound, immediately after the incision has been made.

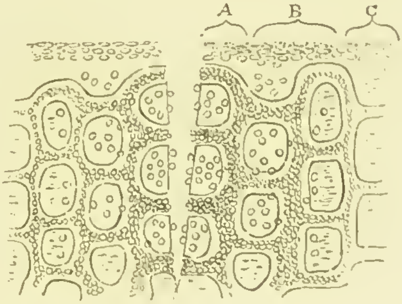

FIG. 18.—Diagram representing an incised wound a few hours after the incision. A. Area of thrombosis—leucocytes making their way to the cut surface; B. Area of dilated capillaries—leucocytes escaping from the vessels into the tissues. C. Normal tissues.

become softened and finally replaced by the infiltrating leucocytes which now form a layer of small round cells welding as it were the surfaces of the wound together (Fig. 19). The inflammation, like all inflammations of traumatic origin, tends to cease as soon as the cause is removed. Thus in a day or two it subsides, and if a section of the parts were now made, the uniting layer of small round cells could be seen permeated by delicate new capillaries stretching across from one side of the wound to the other (Fig. 20). They are generally believed to be produced by loops growing out from the old capillaries, and uniting with others similarly produced, and growing out from the capillaries on the opposite side. This vascularization of the uniting layer of cells accounts

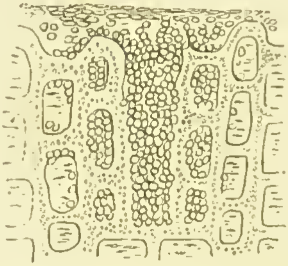

FIG. 19.—Diagram of an incised wound a day or two after the incision. The sides of the wound united by small round cells.

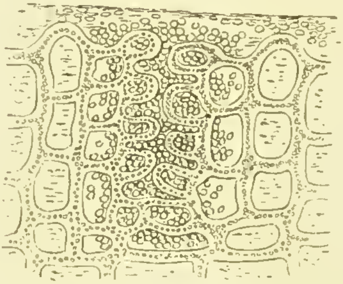

FIG. 20.—Diagram of an incised wound, a few days after the incision. Loops of capillaries growing out from the old capillaries and making their way amongst the small round cells uniting the cut surfaces. At the lower part of the figure a loop has united with one from the opposite side.

for the redness of the cicatricial line, and for the slight hæmorrhage which now occurs if the edges of the wound be drawn forcibly apart. As the capillary circulation is established the edges of the wound become pale from the collateral vessels being now no longer overcharged. The granulation tissue thus formed is at length developed into fibrous tissue, which, like all new fibrous tissue, contracts, obliterating many of the newly-formed vessels. Hence the gradual paling of the cicatrix which now becomes non-vascular.

Healing by the first intention may be prevented by—1. Much contusion of the edges of the wound, with consequent death of the tissues bounding the incision; 2. The presence of a foreign body in the wound; 3. A greatly lowered vitality of the tissues, as from broken health, abuse of alcohol, bad hygienic surroundings, bruising of the parts, rough sponging, or use of too strong antiseptics; 4. The parts not being kept at rest; 5. Inefficient drainage whereby the serum squeezed out from the coagulating material is allowed to collect in the wound and cause tension; 6. Neglect of antiseptic precautions and consequent decomposition of the serum; or the infection of the wound by some of the specific micro-organisms. Under any of the above circumstances the inflammation may be kept up, further infiltration of leucocytes takes place, the small cell exudation uniting the wound breaks down into pus, the flaps separate, and suppuration is established. Supposing the cause of the suppurative inflammation to be now removed, healing by the second intention will take place.

2. *Healing by the second intention.*—New vessels grow out among the layers of small round cells forming the exposed surface of the wound, and granulation tissue is thus formed (Fig. 21). The growth of granulations, other things being equal, exceeds the breaking down of the superficial layers of cells into pus, and the wound is gradually filled up. Epithelium derived from the old epithelium at the edges of the wound gradually spreads over the surface of the granulations; but new sweat and sebaceous glands, hair-follicles, papillæ and lymphatics, are not formed. The cicatrix, at first red from the abundance of the capillaries in the granulation tissue, becomes pale as these are obliterated by the contraction of the fibrous tissue into which the granulation tissue is converted, and though, in the course of time, in conse-

quence of the fibrous contraction, it becomes smaller, a permanent scar will remain.

In wounds attended with loss of substance, in which healing by the second intention is the normal process, a traumatic inflammation is set up in the tissues immediately adjacent to the surface of the wound, and the conditions for healing being otherwise favourable, a coagulable material, as described above, is formed over the surface, and the serum drains away. Loops of new capillaries, derived from the old, spring up amongst the cells replacing the coagulable exudation and softened adjacent tissues, and the wound heals and cicatrizes as has just been described. Where there is much laceration or contusion of the surface of the wound, the dead tissues are cast off by ulceration in the way mentioned under gangrene.

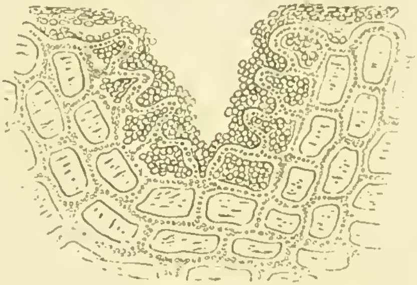

FIG. 21.—Diagram of a granulating wound.

3. *Healing by the third intention.*—When the two layers of granulations covering the flaps of the wound are placed and kept in contact, the capillaries in the one layer meet with those in the other, and so establish a vascular connection between the two flaps, and the healing of the wound then proceeds in the way described under union by the first intention.

4. *Healing under a scab.*—The minute changes of healing under a scab require no special description.

TREATMENT OF WOUNDS.—The general principles which should guide us in the treatment of wounds will be considered under the following heads :—1, Arrest of hæmorrhage ; 2, Cleansing of the wound and removal of foreign bodies ; 3, Drainage ; 4, Closing the wound and keeping it subsequently at absolute rest ; 5, Prevention of putrefaction, fermentation, and infective processes ; and 6, Constitutional treatment.

1. *The arrest of hæmorrhage* is considered separately at page 117.

2. *The cleansing of the wound and removal of foreign bodies* should be done with all gentleness, so as not to bruise more than can possibly be avoided the tissues, the vitality of which is already lowered by the incision through them. Thus the wound should not be sponged or rubbed more than is absolutely necessary, but a stream of water containing some antiseptic allowed to run through it to wash away any dirt, blood-clot, or other foreign substance. If the wound is deep or irregular, it should be syringed out, taking care when the skin-wound is small not to cause any forcible distention for fear of injecting the fluid into the interstices of the tissues where it may act as an irritant and set up suppurative inflammation. Foreign bodies, as glass, splinters, bullets, etc., if lodged in the wound, should be picked out by forceps or other suitable instrument.

Serum

3. *Drainage.*—Except where a wound is quite superficial, and in some situations where the parts are very vascular, as about the face, efficient drainage of the wound is of the greatest importance. Its object is to promote the free escape of the serum, which, as we have seen, is squeezed out during the first twenty-four hours from the coagulable exudation formed upon the surface of the divided tissues as the result of the traumatic inflammation. If this serum is allowed to collect in the deeper parts and irregularities of the wound, it not only mechanically separates the surfaces and gives rise to tension, a cause in itself of the continuance of inflammation and hence of the non-healing of the wound, but is also liable to undergo decomposition and putrefaction. Now the coagulable exudation, being living tissue, resists the agents which determine putrefaction. Not so the serum. In this we have a fluid containing dead animal matter, and as the other conditions favourable for decomposition are also present, viz., a temperature of about 100°, and a sufficient supply of water and oxygen, the addition of a ferment only is required to set it up. If decomposition then is suffered to take place by not protecting the wound by antiseptics, the freshly divided tissues, not as yet sealed by traumatic inflammation, allow of the products of decomposition to soak into the tissues around, setting up locally a septic or spreading inflammation, whereby the coagulable exudation, temporarily holding the surfaces

of the wound in apposition, is destroyed, and healing by the first intention is further prevented. In the meantime the products of decomposition may pass into the blood, and give rise to the constitutional state known as septic traumatic fever, or if the dose of the poison is large, to sapræmia or septic intoxication; and this is the more likely to occur if the wound has been closed, so that the decomposing serum is pent up under some degree of tension. If therefore the wound is large, and deep or irregular, a drainage tube or tubes should be placed in it, and brought out at the most dependent part, the incisions, if the wound is made in an operation, being so planned as to allow as much as possible of a dependent drain. For smaller wounds it may be sufficient to place in a leash of horse-hair or of cat-gut, a piece of gutta-percha tissue, or a strand or two of pewter wire. The drain-tube if kept in too long will act as a foreign body, set up inflammation, and give rise to a suppurating sinus along its track. It should therefore be withdrawn as soon as the serum ceases to be squeezed out from the coagulating material—*i.e.*, from twenty-four to forty-eight hours, according to the size of the wound. In large and deep wounds it is better not to remove the tube all at once, as the superficial part of the wound may then heal, and the discharge or pus collect in the deeper part; but to shorten it gradually, allowing the wound to soundly heal as it is withdrawn. The drain-tube should consist of red-rubber tubing varying in calibre according to the size of the wound. It should have lateral holes cut in it to facilitate the escape of the discharge, and should be made thoroughly aseptic by being kept in some antiseptic fluid. It had better be passed through the first layer of dressing, and its mouth surrounded by some absorbent material to take up the discharges. Where the wound is deep, the tube should be secured by an antiseptic thread, lest it slip in, and becoming lost in the depths of the wound, subsequently act as a foreign body. Tubes of decalcified bone have been used in the hope that they would become absorbed, and so prevent the necessity of disturbing the dressings; but they do not appear to have had the desired effect. Recently a reaction seems to have set in against the use of drains of all kinds. Where they are dispensed with the skin wound is not as a rule tightly closed, and the deeper parts of the wound are maintained in close opposition by means of buried or deep sutures and the application of firm pressure over a thick layer of absorbent and antiseptic dressing.

4. *Closure of the wound.*—The surfaces should be placed in contact, and the edges accurately united by suture, strapping, or a bandage. Where the wound involves different layers of tissue, muscle and fascia should be united, each to each, by animal sutures, such as catgut or kangaroo-tail tendon, made aseptic by soaking in carbolic acid (1 in 40). In uniting the edges of the wound, care should be taken to see that the skin is neither inverted nor everted, and that the sutures, whatever form is used, are only applied sufficiently tightly to keep the edges in apposition. All tension should be avoided, as this in itself is a fertile cause of inflammation. The sutures may consist of silver-wire, silk, catgut, silkworm-gut, or horse-hair. All kinds have their advantages and disadvantages, and are variously required in different cases. Thus, silver-wire is unirritating and perfectly non-absorbent, but causes pain on removal, and, as it is quite unyielding, is apt, from the swelling of the parts, to cause tension and inflammation if left in too long. Catgut is useful in that its deeper parts become absorbed, and therefore does not require removal. For this reason it is often inapplicable, as it gives way too soon. Catgut when chromicized, however, resists absorption for many days, and forms an admirable suture. Horse-hair is non-absorbent, and is also non-absorbable; it has the additional advantage of being slightly yielding, as well as sufficiently supporting. It is very useful when a delicate suture is required, as in wounds about the face. Silk forms a strong suture, but possesses the disadvantage of being absorbent, and thus of becoming saturated with the discharges; so that, if decomposition takes place, it will

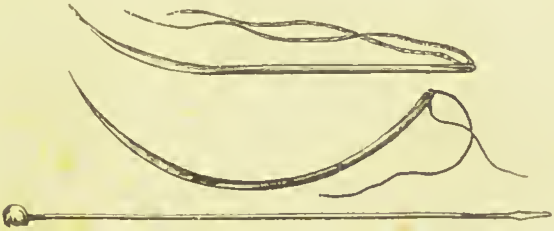

FIG. 22.—Surgical needles and hare-lip pin.

act as an irritant. Further, unless tied tightly, in which case it is apt to produce tension, it yields too much.

The sutures are introduced by various forms of surgical needles, curved and straight, bayonet- spear- and probe-pointed, the needle being conveniently passed by one of the many forms of needle-holder (Fig. 23). The methods of applying sutures are very numerous. The two chief forms of suture used in ordinary wounds are the *interrupted*, the suture being tied or twisted at each stitch and cut off short, and the *continuous*, one suture being used throughout without being cut. Among the special forms may be mentioned the twisted, the button, the quilled, the Lembert, the Jobert, and the Czerny, which are referred to under those wounds where they are specially indicated. The other methods of closing wounds, as by styptic colloid and collodion, are useful in wounds about the face, and where the wound is small. Having closed the wound, the parts should be placed as far as is possible at absolute rest, and supported by firm but elastic pressure to ensure the deeper surfaces being in co-aptation.

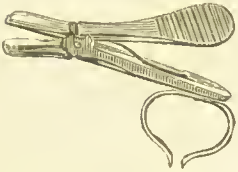

Fig. 23.—Convenient needle-holder.

5. *Prevention of putrefaction, fermentation, and infective processes occurring in the wound.*—Putrefaction and fermentation are best prevented by efficiently draining the wound, as, where this is accomplished, there is no material left wherein decomposition can occur. Antiseptics, viz., materials that prevent putrefaction and fermentation by destroying septic and infective organisms, are usually adopted as an extra precaution, and are especially necessary where thorough drainage, as in some forms of compound fracture, wounds of joints, etc., cannot be ensured.

But we have to guard, not only against the decomposition of the discharges and subsequent infection of the wound, but also against the entrance of infective micro-organisms, conveyed by sponges, the Surgeon's or nurse's hands, or by the air when an infectious case is in the ward. Thus, the greatest cleanliness is necessary; all instruments should be carefully cleansed after use before they are put away, and before and whilst in use placed in some antiseptic solution, as carbolic acid (1 in 40). Sponges had better not be used at all, but Gamgee's absorbent pads, which can be destroyed immediately after the operation. The hands of the Surgeon should be scrupulously clean, and further purified by dipping them into carbolic acid (1 in 40), or corrosive sublimate (1 in 2,000). Previous to operating, the parts should be shaved, and washed with soap-and-water for some distance around where the wound is to be made, and afterwards with carbolic acid (1 in 20), or corrosive sublimate (1 in 2,000), and where greasy, with ether. The carbolic spray is now fast being abandoned, and irrigation with corrosive sublimate (1 in 5,000), carbolic acid (1 in 40), or even pure water substituted for it.

In a work of this character, it would be impossible to attempt any description of the numerous methods of dressing wounds which have been, or are at the present day, in use, and to adequately discuss the advantages claimed for them, and the disadvantages which all of them to a greater or less degree possess. The objects aimed at in the selection of a dressing are—1, that it should be absorbent, so as readily to soak up the discharges drained off from the wound; 2, that it should promote the drying of the wound; 3, that it should be antiseptic; and, hence, 4, that, it should not require frequent changing, and the consequent disturbance of the wound and therefore of that rest which is so important in promoting physiological repair. The materials most frequently used are gauze, cotton-wool, or wood-wool, impregnated with carbolic acid, salicylic acid, iodoform, eucalyptus oil, sanitas, corrosive sublimate, etc. My own plan is to well dust the surface of the wound with iodoform, and afterwards dress it with several layers of either iodoform or sal alembroth gauze, over which is placed more gauze impregnated with eucalyptus oil, and firm compression with a bandage applied. The wound, if small, or of moderate size, is then left absolutely at rest till healing is thought to have taken place; if large, however, the dressings are removed on the second or third day for the purpose of extracting the drain-tube, but are not again changed, as a rule, till the wound has healed. The temperature and pulse are, of course, carefully watched; and should they indicate any abnormality in the process of healing, or should there be local pain or uneasiness, the dressings are removed.

6. *Constitutional treatment.*—Whether the wound is received accidentally, or is inflicted in the form of an

operation, much of the Surgeon's success will depend upon judicious constitutional after-treatment; and, indeed, in the latter case, in great measure also upon the preparation of the patient. Where the wound is large and there has been much hæmorrhage, the condition known as shock, and the constitutional symptoms depending upon severe loss of blood, will probably ensue. For the treatment of these see *Shock* and *Hæmorrhage.* For the wound to do well it is important that the patient should be placed under the best possible hygienic conditions. He should have an abundant supply of fresh air, the secretions should be regulated, and the diet carefully supervised. Thus, he should have at least fifteen hundred cubic feet of air, and this should be changed by efficient ventilation once every hour. The windows, in addition, except in very severe weather, should be opened at regular intervals, in order to thoroughly flush out the room; but draughts must be avoided, and the temperature of the room maintained at a uniform degree of about 60 F. A horsehair mattress should be employed, and a draw-sheet placed on the bed. The room or ward should be scrupulously clean; there should be no curtains to the bed and windows, nor carpet on the floor, and nothing under the bed to interfere with the free circulation of air. The bowels should be kept regular by small doses of confection of senna or of the compound liquorice powder, or by one of the laxative mineral waters; the secretion of the skin promoted by washing, which may be done without unduly exposing or wetting the patient; and sleep induced, if necessary, by small doses of bromide of potassium, urethane, chloral or opium, or by subcutaneous injections of morphia. The patient must be kept cheerful by books, newspapers, etc. The diet for the first few days should be limited to milk, weak beef-tea, or chicken-broth, and gradually increased as the temperature falls to normal and the digestive functions regain their power. Where the strength has been much reduced previous to the operation, or the operation has been severe, or the shock marked, or hæmorrhage free, or suppuration has ensued, stimulants, varying in amount according to the state of the pulse, temperature, and tongue are indicated. The treatment necessary for the various complications that may attend the healing of wounds are given under Inflammation, Suppuration, Erysipelas, etc. As regards the *preparation for operation*, where this is not one of emergency the patient should be placed at rest for a few days, and kept cheerful and in good spirits, and put on nourishing but unstimulating diet. In the meantime his digestive, alvine, renal, and cutaneous functions must be regulated by appropriate means, the bowels being cleared the day before the operation by a dose of castor-oil or other mild purgative. Where his strength is much reduced by long-continued suppuration or chronic disease, efforts must be made to improve his general health by nourishing diet and the judicious employment of stimulants.

VARIETIES OF OPEN WOUNDS.—Open wounds are divided into incised, lacerated, contused, punctured, and poisoned.

Incised wounds are such as have their edges evenly divided and their surfaces smoothly cut. They are usually inflicted by sharp instruments, and are those commonly made by the Surgeon in operating. The danger to which they are particularly exposed is hæmorrhage. Healing is generally accomplished by the first intention, provided the proper means are employed. *Treatment.*—What has been said under the treatment of wounds generally, applies especially to this variety.

Lacerated wounds are those in which the tissues forming the surface and edges of the wound are irregularly torn. They are commonly caused by machinery and by the goring and bites of animals. There is usually but little hæmorrhage, in consequence of the vessels being torn rather than cut across. The chief dangers are profuse suppuration, tetanus, sapræmia, erysipelas, and extensive scarring. Healing is generally accomplished by the second intention, the dead portions of the lacerated tissues being first thrown off by ulceration in the way described under Gangrene. In some situations and under favourable conditions, however, a large part of the wound may heal by the first intention. *Treatment.*—Special attention should be paid to the cleansing of the wound and establishing a free drain. Any portions of the tissues which have obviously lost their vitality should be cut away. Sutures should not as a rule be applied, but the wound should be dressed by one of the methods before described, and the parts placed at rest.

Contused wounds are those in which the tissues forming the surface and edges are extensively bruised. They are usually made with blunt instruments, or with such agents as distribute the force over a large surface. There is commonly considerable extravasation of blood amongst the bruised tissues, though usually but little external hæmorrhage, the chief dangers being extensive inflammation and sloughing, secondary hæmorrhage on the separation of the sloughs, spreading gangrene, erysipelas, or diffuse cellulitis, tetanus, and, later, scarring. A combination of laceration and contusion is frequently present. Healing is generally accomplished by the second intention. The *Treatment* is similar to that of lacerated wounds. Any portions of skin which have not lost their vitality should be preserved, especially if the wound involves the scalp or face.

Punctured wounds are those in which the depth is much greater than the breadth. They are usually produced by sharp-pointed instruments, bayonet- or sword-thrusts, and stabs. The chief dangers are hæmorrhage, penetration of important cavities, as the thorax, abdomen, or a joint, injury of a large blood-vessel or nerve, and subsequently deep suppuration in consequence of the retention of the discharges in the deep portion of the wound. Punctured wounds usually unite by the second intention, owing to the difficulty of keeping the deeper part of the wound in contact and of preventing the collecting of serum and later of pus. *Treatment.*—If deep, a drainage-tube should be passed to the bottom of the wound, and gradually shortened as the wound heals. If there is severe arterial hæmorrhage which cannot be controlled by carefully applied pressure, the wound must be converted into an incised one, and the bleeding vessel treated in the way described under wounds of arteries, veins, etc. For the special treatment required where a joint or visceral cavity has been penetrated, see *Injuries of Regions.*

POISONED WOUNDS. *Dissection and post-mortem wounds.*—Dissection wounds are of frequent occurrence, but seldom give rise to any serious trouble, unless the body from which the poison is received is fresh, when the risks are similar to those attending wounds received in making *post-mortem* examinations. *Post-mortem* wounds appear to owe their virulence to inoculation with infective micro-organisms which are capable of multiplying in the tissues or in the blood, and so setting up true infective inflammation and blood-poisoning. These micro-organisms are replaced, as decomposition of the corpse sets in, by the bacteria of putrefaction (*bacterium termo*). Hence the longer the body has been kept the less dangerous the wound, as these bacteria are merely capable of inducing a local inflammation, and not a true infective process. The most dangerous wounds are those received whilst examining bodies in which death has recently resulted from septicæmia, pyæmia, diffuse or puerperal peritonitis, and erysipelas. The effects of a wound received in dissection, or in *post-mortem* inspection, will depend in some degree upon the health of the operator; if strong and vigorous he is better able to resist the toxic effects than when debilitated by prolonged study or work in a hospital ward. On the other hand, persons acclimatized to the dissecting or *post-mortem* room are less liable to be affected than those who have but recently been engaged there.

The *signs*, as might be expected from what has been said above, vary considerably, depending, as they do, upon the nature of the poison received from the corpse and the previous state of the operator's health. Thus: 1. A pustule may form at the seat of inoculation, and, after breaking and scabbing, leave a raised, indolent, painful red sore, which may exist for months in spite of treatment. 2. The wound may become inflamed, the superficial, and, perhaps, the deep lymphatics implicated, and the axillary glands enlarged and painful, this condition being attended by sharp constitutional disturbance, often preceded by a rigor. Suppuration generally occurs in the wound, and sometimes also in the axillary glands. The prognosis is usually good. 3. With or without the local signs of the preceding form, severe constitutional symptoms set in, preceded by a rigor, and rapidly assume a typhoid character. Diffuse suppuration occurs in the axillary glands, and may spread to the neck and side of the chest. The prognosis is very unfavourable, the patient often dying in from one to three weeks, or only recovering after a tedious convalescence, and then, probably, with a broken constitution. 4. Diffuse cellular, or cellulo-cutaneous erysipelas is set up at the seat of the wound, attended with the usual constitutional symptoms of these affections, and may rapidly spread up the limb and terminate in gangrene and death. The axillary glands in this form are not usually affected. 5. In addition to the local suppuration, a pyæmic state, with the formation of metastatic abscesses in various tissues and organs, sometimes occurs.

Treatment.—Immediately on its infliction the wound should be sucked, and cleansed by a stream of cold water, and bleeding encouraged by tightly binding the part above the wound. Where the corpse is recent and death is known to be the result of some infective disease, the wound should be washed in strong carbolic lotion (some recommend its cauterization with caustic potash, or nitrate of silver), and then dressed with iodoform, and protected from further infection. If a wart, or indolent sore form, it should be destroyed by nitrate of silver, or other caustic, and the patient's health improved by tonics and change of air. If an infective inflammation be set up, the wound should be freely incised, and any abscess that may form in the axilla, or elsewhere, opened early; indeed, if there is much tension or brawniness of the parts, incisions should be made before pus is formed. The bowels in the meantime should be cleared by a brisk purge, and the strength supported by nourishments and stimulants.

Stings of insects sometimes cause troublesome local inflammation, which is occasionally of a diffuse character, and where a large extent of surface is stung, as by a swarm of bees, may be attended with symptoms of severe depression. Stings of the throat occasionally occur from swallowing a wasp, and are liable to be followed by œdematous laryngitis.

Treatment.—The application of ammonia will at once relieve pain. Where there is severe depression, ammonia or alcohol must be administered. Scarification, intubation of the glottis, or even laryngotomy, may become necessary in severe stings of the throat.

Stings of serpents.—The bites of poisonous snakes, other than the adder, are fortunately rare in this country. The bite of the common adder is seldom fatal. It is attended with much collapse, nausea or vomiting, great pain in the part, swelling of the affected member, subsequent discoloration from blood-extravasation, and occasionally inflammation and suppuration. The *treatment* consists in sucking the part where practicable, applying a bandage tightly above the bite to prevent absorption of the poison, and the internal administration of stimulants. The local application of liquor potassæ or permanganate of potash, the injection of ammonia into the veins, and excision of the bitten part are recommended. For an account of the more serious symptoms attending the bite of the cobra and other venomous serpents of tropical countries, a larger work must be consulted.

SUBCUTANEOUS WOUNDS.—A wound, whether it be of the connective tissue, bone, muscle, tendon, or other structure, is said to be subcutaneous when the skin or mucous membrane remains intact. Such wounds differ from the open in that they heal by adhesive inflammation without suppuration, since as long as the skin or mucous membrane covering the wounded part is unbroken, septic processes are effectually prevented. Moreover, they are attended by but little, if any, constitutional disturbance. They will be further described under *Rupture of Muscles and Tendons*, *Simple Fractures*, *&c.*

DISEASES OF CICATRICES.—The cicatrices left on the healing of a wound are liable to certain affections which may be enumerated as :—1, painful cicatrix ; 2, depressed or contracted cicatrix ; 3, warty cicatrix ; 4, thin cicatrices ; 5, ulceration ; 6, keloid ; and 7, epithelioma. See *Ulceration*, *Tumours*, *Injuries and Diseases of Nerves*, *&c.*

CONTUSIONS OR BRUISES.

CONTUSIONS are subcutaneous injuries, occasioned by a crushing, pulping or tearing of the tissues, combined with extravasation of blood consequent upon the rupture of the capillaries and smaller vessels of the part. In their slighter forms they constitute the common injury known as a *bruise*. The effused blood generally makes its way in the connective-tissue planes towards the skin, giving rise to the characteristic purplish-black appearance, and, as it later becomes absorbed, to a change of colours from bluish-black through dark red to yellowish-green. In severe cases the cuticle is raised into bullæ by the effusion of blood-stained serum beneath it. These bullæ, together with the black colour of the part, may occasion a close resemblance to gangrene, from which however a contusion may be distinguished by there being no loss of heat or of sensation in the part, and by the bullæ being fixed, and not changing their position on pressure as in gangrene. In very severe and extensive contusions, however, the tissues may be so injured as to lose their vitality, and gangrene actually ensue ; whilst in other instances inflammation and suppuration may occur. When the contusion is localized, blood to a considerable amount may be poured out at the injured spot, forming a fluctuating swelling known as a *hæmatoma*. Contusions of muscle, bone, blood-vessels, and nerves, and of the viscera, are considered separately under Injuries of Special Tissues and Organs.

Treatment.—Beyond placing the part at rest, and applying an evaporating or a spirit lotion, nothing more as a rule is required, as the extravasated blood presses upon the injured vessels, and so prevents further hæmorrhage. Should a hæmatoma form, it should on no account be opened, as the blood will usually become absorbed; whilst, if air be admitted, suppuration will probably ensue. Aspiration, however, when the hæmatoma is very large, may occasionally be done with advantage.

BURNS AND SCALDS.

BURNS AND SCALDS vary in their effect according to their depth, extent, situation, and the age of the patient. An extensive though superficial burn on the trunk, head, or face, especially in a child, may be more serious than a deeper but limited burn on the extremities. A burn is usually said to be more severe than a scald, as the fluid producing the latter generally quickly cools and runs off. A scald, however, owes its severity to the large extent of surface usually implicated, and when produced by molten metal or boiling-oil which adheres to the part is generally very serious. Burns and scalds, when severe, give rise to constitutional as well as local effects. The local effects may be considered under Dupuytren's division of burns into six degrees. These degrees, however, may be variously combined in the same burn.

1ST DEGREE.—*Simple erythema*, due to increased flow of blood through the dilated vessels. No tissue destruction ensues, and no scar is left.

2ND DEGREE.—*Vesication*, due to the exudation from the dilated capillaries of the cutis causing the superficial layers of the epithelium to be raised from the deeper in the form of blebs. No scar is left, as only the superficial layers of the epithelium are destroyed, and these are soon reproduced from the deeper layers. Some slight staining of the skin, however, may subsequently remain.

3RD DEGREE.—*Destruction of the cuticle and part of the true skin.*—The epithelium around the hair-follicles, in the sweat-glands, and between the papillæ, escapes, and rapidly forms new epithelium over the granulating surface left on the separation of the slough. A scar results, but as it contains all the elements of the true skin, the integrity of the part is retained, and hence there is no contraction. It is the most painful form of burn, as the nerve-endings are involved but not destroyed.

4TH DEGREE.—*Destruction of the whole skin.*—The sloughs are yellowish-brown and parchment-like; and their separation is attended by much suppuration. As the nerve-endings are completely destroyed, the pain is much less than in the former degree of burn. The epithelium which covers in the granulating surface is only derived from the margins of the burn, and the resulting scar consists of dense fibrous tissue. Hence the extensive contraction and great deformity which often result.

5TH DEGREE.—*Penetration of the deep fascia and implication of the muscles.*—Great scarring and deformity necessarily follow.

6TH DEGREE.—*Charring of the whole limb.*—The parts are separated by ulceration in the same way as in gangrene.

CONSTITUTIONAL EFFECTS.—When the burn is superficial and of small extent, there may be no constitutional symptoms; and even when it is deep, but limited to one of the extremities, as the foot or hand, they may also be slight. When, however, the burn is extensive, and especially when it involves the chest, abdomen, or head and neck, even although it is only of the first or second degree, the symptoms may be severe, more particularly when the patient is a child. They may be divided into three stages:—1. *Shock and congestion.* 2. *Reaction and inflammation.* 3. *Suppuration and exhaustion.*

1ST STAGE.—*Shock and congestion.*—The shock is often very great, especially when the burn is extensive, and involves the trunk, or head and neck. The patient is pale and shivering, the pulse feeble and fluttering, and the extremities are cold; he suffers little or no pain, and sometimes passes into a state of coma and dies, the chief *post-mortem* appearances being congestion of the internal organs, particularly the brain.

2ND STAGE.—*Reaction and inflammation.*—Reaction comes on from twenty-four to forty-eight hours after the burn. The pulse is full, strong, and rapid, the temperature rises, and there are other symptoms of fever. Inflammation is set up around the burnt part, and there is now danger of the absorption of the septic products derived from the putrefaction of the sloughs which are beginning to separate. The congestion of the internal viscera, so common in the former stage, may run on into inflammation; and pleurisy, pneumonia, peritonitis, or meningitis may supervene and prove fatal. Perforating ulcer of the duodenum, attributed to Brunner's glands taking upon themselves the function of the injured glands in the burnt skin, may now occur, and is said to be most frequently met with about the tenth day.

3RD STAGE.—*Suppuration and exhaustion.*—During this stage, which sets in on the separation of the sloughs, there is still a danger of the patient succumbing to inflammation of the viscera, especially the thoracic; or he may be worn out by hectic and exhaustion from long-continued suppuration. He is also exposed to the risks of secondary hæmorrhage on the separation of the sloughs, and to blood-poisoning from the absorption of septic products unless the greatest care is exercised to prevent the decomposition of the discharges. On cicatrization occurring, horrible deformity may ensue from the contraction of the newly-formed fibrous tissue in the scars.

The *Treatment* must be both local and constitutional.

Local treatment.—The clothes should be removed with the greatest care, so as not to tear off the cuticle; but undue exposure should be avoided. In burns of the first and second degree, the part should be protected from the air and change of temperature by smearing it with vaseline and wrapping it in cotton-wool, the blisters being pricked to relieve tension and to let out the serum. The cuticle, however, should not be removed, as it serves as the best protective. In burns of the third degree, the parts may also be protected by cotton-wool till the sloughs begin to separate. Decomposition of the discharges should then be prevented as much as possible by mild antiseptic dressings. Thus, the surface may be dusted with iodoform; or eucalyptus oil, boracic lotion, and the like may be applied. Some Surgeons put on a charcoal or even a linseed-meal poultice. Carbolic acid should not be used, as not only is it too irritating, but there is danger of its being absorbed when the burn is very extensive. When the sloughs have separated, and granulation sets in, the wound may be treated as described under simple ulcer, redundant granulations being repressed by nitrate of silver. Skin-grafting is often useful in the fourth degree of burns. The fourth and fifth degrees require the same treatment as the third.

but during cicatrization, contraction must be as far as possible prevented by the use of elastic tension, extension-apparatus, splints, &c. Later some form of plastic operation to overcome the effects of the contractions will often be required. In the sixth degree, amputation, if a limb is affected, will probably sooner or later be called for.

Constitutional treatment.—If the shock is severe, stimulants in the form of brandy or ammonia should be given according to the state of the pulse, the patient covered with blankets, hot bottles applied to the feet, and undue exposure on removing the burnt clothes and on applying the dressings as much as possible avoided. Opium should be given, especially if there is much pain. As soon as the patient can bear it, fluid nourishment should be substituted for stimulants, as the latter, if given in large quantities, only tend to produce excessive reaction and inflammation. During the second stage, little can be done beyond regulating the bowels and secretions; lowering treatment is not well borne, at any rate when the burn is extensive and deep, as the patient will then require all his strength to sustain the drain on his system during the casting off of the sloughs and the long suppuration following. The inflammatory fever, moreover, generally assumes, if it is not so from the first, a low type. A stimulating plan of treatment, rather than a depressing, is therefore necessary. In the third stage, the patient's strength should be supported by abundant nourishment and stimulants.

LIGHTNING-STROKE.—Death may be instantaneous, or the stroke, beyond causing temporary unconsciousness, may do no harm. In some instances, superficial or deep burns, or paralysis of certain nerves, as the optic, auditory, &c., have been produced. The *treatment* consists in applying warmth, artificial respiration, and stimulants whilst the patient is in a state of shock. The function of the nerves if paralysed have sometimes been restored by galvanism.

HÆMORRHAGE.

IN speaking of the treatment of wounds it was stated that our first care should be to staunch hæmorrhage. This requires different measures according as it is arterial, venous, or capillary. It is therefore first necessary to be able to distinguish between these varieties. Usually it is quite easy. In *arterial hæmorrhage* the blood escapes in jets, the force of which is increased at each systole of the heart, and is of a bright scarlet colour. In *venous hæmorrhage* the blood wells up from the wounded vessel usually in a continuous stream, and is of a dark purplish-red colour. In *capillary hæmorrhage* the blood appears to ooze from all parts of the wound, trickling down its sides to the deeper parts, where it forms a little pool. In some instances, however, as where arterial blood escapes from a deep and devious wound, it may resemble venous blood in that it flows continuously instead of in jets, and when the patient is partially asphyxiated, as from too large a dose of an anæsthetic, it becomes of a dark colour. On the other hand venous blood exposed to the air in its passage from a deep wound may undergo oxygenation and become bright like arterial. Bleeding from the corpus spongiosum and corpora cavernosa of the penis, or from like tissues consisting of cavernous blood-spaces or numerous small arteries and veins, is sometimes spoken of as *parenchymatous hæmorrhage.* When hæmorrhage occurs in a visceral cavity, as the pleura or peritoneum (*internal hæmorrhage*), or into the substance of the tissues of the trunk or extremities (*extravasation*), it is known by special signs, and is treated of elsewhere.

Constitutional effects of hæmorrhage.—The effect upon the constitution of course varies according to the amount of blood lost, and is more marked when the blood is rapidly poured out from a large artery than when it escapes slowly from a small artery or from a vein. In the former case the patient may die in a few minutes of syncope. When the bleeding is less severe the face and general surface become blanched and cold, and the lips and mucous membrane pallid. The pulse is feeble, fluttering and rapid, and at length only to be felt in the larger vessels. The skin is bathed in profuse perspiration, the respiration is sighing, and the mind wanders. These symptoms may end in syncope, convulsions, and death; or the patient may slowly recover, or may suffer from anæmia or functional disturbance for years. If he is old, some secondary disease is apt to be engrafted on this state of anæmia, of which he may die. Children, moreover, bear the loss of blood badly, but recover rapidly; the old stand the loss better, but the effect on their constitution is more permanent.

Constitutional treatment of hæmorrhage.—When the bleeding has been severe, immediate steps must be taken to prevent fatal syncope; and after this danger has been tided over, we must then seek to counteract the remote effects produced upon the whole system by the loss of blood. 1. *Immediate treatment.*—Our efforts must first be directed to arrest, or at any rate to temporarily control, the hæmorrhage by some of the local measures to be presently described. Having done this, the chief indication is to prevent fatal syncope by ensuring a sufficient supply of blood to the brain to excite the cardiac centre in the medulla oblongata. Thus, the patient should be laid on his back with his head low, his body warmly covered up, and hot bottles placed at his feet; or, if the pulse does not improve, stimulants in small quantities should be administered, by the mouth if he can swallow, otherwise by the rectum or by subcutaneous injection; whilst in severe cases the legs and arms should be held up, or an Esmarch's bandage applied to them in order the better to drive the blood to the brain. As a last resource, transfusion of blood should be practised. Where the bleeding is internal or cannot be arrested, stimulants should be avoided, inasmuch as the syncope into which the patient has fallen tends temporarily to stop the bleeding by inducing clotting of the blood in the wounded vessels. If the heart be again roused to action by stimulants and the vessels in consequence become dilated, the clots may be displaced, the bleeding re-started, and the last flickering spark of life put out. 2. *To counteract the remote effects* of the loss of blood, fluid nourishment should be given in small quantities, and then eggs, fish and finally meat. Iron is required to restore the loss of hæmatin, and a sea-voyage or prolonged residence in the country is beneficial in overcoming the anæmia.

TRANSFUSION OF BLOOD may be required in cases where death is threatened from excessive hæmorrhage. If blood cannot be readily obtained, milk or a saline solution may be substituted for it. The blood, if possible, should be taken from a healthy adult, and should be transfused by Aveling's (Fig. 24) or Roussel's apparatus directly from the arm of the giver to the arm of the patient; or, if no special apparatus is at hand, the blood should be drawn into a clean vessel, kept at a temperature of from 98° to 100°, and injected into the vein by an aspirator or other suitable syringe. Great care must be taken to see that the syringe is quite full before its nozzle is introduced into the vein, lest air as well as blood enter the circulation. Another danger to be guarded against is the clotting of portions of the blood and the consequent plugging of some of the patient's vessels. This is avoided by not allowing the blood to cool below 98°, or to remain in the recipient vessel longer than possible. As an extra precaution some whip the blood to extract the fibrin, and then filter it through a piece of fine muslin before injecting it. A vein at the bend of the elbow is usually chosen for this operation. About two ounces of blood is generally required, but the exact amount will depend to some extent upon the effect produced upon the patient. It need hardly be said that the greatest cleanliness is absolutely necessary to prevent ill effects both to the recipient and the donor.

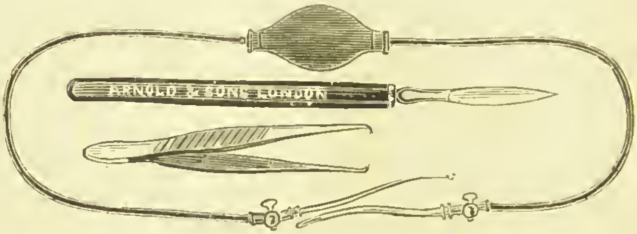

FIG. 24.—Aveling's Transfusion Apparatus.

THE LOCAL TREATMENT OF HÆMORRHAGE may be considered under the heads of arterial, venous, and capillary hæmorrhage.

ARTERIAL HÆMORRHAGE is spoken of as (1) primary, (2) reactionary or recurrent, and (3) secondary.

1. *Primary hæmorrhage* is that which occurs at the time an artery is wounded, whether by accident or surgical operation. 2. *Reactionary or recurrent hæmorrhage* is that which occurs on the patient recovering from the shock of the wound or operation after the primary hæmorrhage has stopped, and may be regarded as a failure in the process for the temporary closure of the vessel. The term recurrent, therefore, should only be applied to hæmorrhage occurring within twenty-four hours of the injury. 3. *Secondary hæmorrhage* is that which occurs any time after the first twenty-four hours, and is due to the failure of the process for the permanent closure of the vessel. The treatment in each case is different.

1. Primary arterial hæmorrhage.—The older Surgeons resorted to very barbarous methods of controlling hæmorrhage, such as plunging stumps after amputation into boiling pitch, or operating with a red-hot knife, and it was not till Nature's method of arresting bleeding had been intimately studied, both in the human subject and by experiments on animals, that the local treatment of hæmorrhage was placed upon a scientific basis. It may be best, therefore, first to consider *Nature's method of controlling hæmorrhage* before describing the surgical measures which have been founded upon it. When an artery of small or moderate size is completely divided, the cut end, in consequence of the injury stimulating the muscular fibres of the middle coat, *contracts*, thus lessening the size of the orifice, and, in the case of the small arteries, completely closing it. At the same time, the cut end, owing to the normal elastic tension of the artery, *retracts* within its sheath, leaving the surface of the latter rough and uneven. The diminution in the size of the orifice retards the escape of blood. The slower current passing over the divided wall of the artery and the roughened internal surface of the sheath, in consequence of this multiplication of points of contact and exposure to the air, coagulates, gradually blocks up the orifice, and fills the sheath around and beyond the retracted end of the artery, forming what is called the *external clot.* The stream having been thus slowed or stopped, the blood inside the vessel also coagulates, and the coagulation spreading from the clot that blocks up the orifice to the first collateral branch, forms what is called *the internal clot* (Fig. 25). When the hæmorrhage has been severe, two other factors favour the formation of these clots, viz., (1), the enfeeblement of the heart's action induced by the tendency to syncope, and the consequent diminished force with which the blood is propelled from the divided vessel; and (2) the increased tendency of the blood to coagulate owing to an alteration in its composition caused by the absorption of watery fluid from the

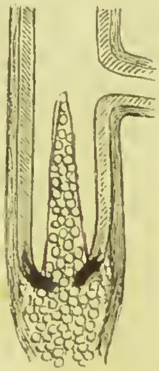

Fig. 25.—Diagram of a wounded artery closed by clots.

tissues to make up for the amount of blood lost by the hæmorrhage. Thus the hæmorrhage is arrested, and still presuming that the vessel be of a small or a medium size, it may not recur, and nature will permanently close the wounded vessel in the way to be presently described. It is only, however, when the vessel is small, that nature can be thus trusted. When a large vessel is wounded, she is quite impotent to prevent an immediately fatal issue ; whilst if the vessel is of medium size, as the syncope passes off, and the heart again begins to act with vigour, the clots may be washed away and the bleeding recur till fainting once more ensues. In this way bleedings, alternating with temporary arrests, exhaust the patient's strength, till he finally succumbs to fatal syncope.

The method by which nature permanently closes the vessel is as follows:—The clot between the artery and the sheath prevents the artery from dilating on the cessation of the contraction of the muscular fibres of the middle coat; whilst the internal clot acts, so to speak, as a buffer, and thus prevents the force of the blood-stream being exerted to its full on the end of the vessel while healing is taking place. The injury inflicted on the coats of the vessel by its division sets up a 1. traumatic inflammation. 2 Leucocytes and serum escape from the vasa vasorum of the divided vessel-walls and tissues about the cut end of the vessel, and gradually permeate both the internal and external clots so that the end of the artery in a few hours becomes surrounded by a small mass of coagulable lymph. 3 The artery at the same time contracts on the internal clot, which gradually loses its red colour as it is invaded by the inflammatory exudation. 4 New vessels grow out from the vasa vasorum of the arterial wall, and from the granulation tissue about the cut end of the vessel, and invade the inflammatory exudation, which has now replaced the internal clot. 5 Thus the internal clot, instead of as at first being merely adherent by its base to the end of the divided artery, is now intimately blended with the arterial walls, forming a plug of vascular granulation tissue. 6 The granulation tissue is next converted into fibrous tissue, which gradually contracts and obliterates the newly-formed vessels, till finally the internal clot together with the artery is converted as far as the first collateral branch into a firm fibrous cord.

Similar changes, in the meanwhile, occur in the external clot, and it is finally blended with the scar tissue formed by the healing of the wound of the soft parts around the injured artery.

When an artery is divided in its continuity, the healing of the distal end is accomplished in a similar manner, except that the internal clot in the distal end is often less perfectly produced, and may not be formed at all. Consequently, secondary hæmorrhage is more frequent from the lower than from the upper end of a ligatured artery.

The above description applies chiefly to a complete division of an artery. When an artery is merely punctured, the arrest of hæmorrhage will depend upon the size of the vessels, and the size and direction of the puncture. A wound, however small, of the aorta, or vessel next removed in size, will probably be fatal. In a vessel of less magnitude, when the puncture is small, a clot forms of an hour-glass shape, thus blocking up the wound, and healing occurs by adhesive inflammation. 1st intent
A somewhat larger wound, when made longitudinally to the artery, may heal in the same way; but when made transversely to the axis of the vessel, it assumes a diamond shape, in consequence of the elastic tension of the coats, and the hæmorrhage will probably not be arrested.

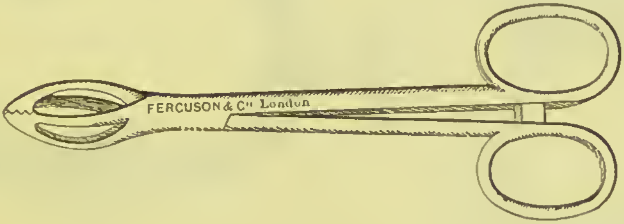

Fig. 26.—Spencer Wells' pressure forceps, modified by Morrant Baker.

The SURGICAL METHODS OF ARRESTING HÆMORRHAGE may be considered under the heads of temporary and permanent methods.

1. *Temporary methods.*—The Surgeon, if the bleeding point is within reach, need never fear hæmorrhage, as mere pressure with the finger will control it, whatever the size of the vessel, till he can obtain the means of permanently arresting it. The pressure may be made directly on the bleeding point, or between the wound and the heart; in the former situation with the finger, Spencer Wells' pressure forceps (Fig. 26), or the

tourniquet; in the latter situation with the finger or the tourniquet, the pressure being then made in such a direction as to press the artery against some resisting structure, as a point of bone. The tourniquets employed are various (Fig. 27 and Fig. 28). The rubber tube of the Esmarch's apparatus perhaps answers the best. An impromptu tourniquet may be made by binding a pocket-handkerchief loosely round the limb, and twisting it up tightly with a walking-stick or umbrella. These temporary means, however, should only be trusted to until more permanent methods can be applied.

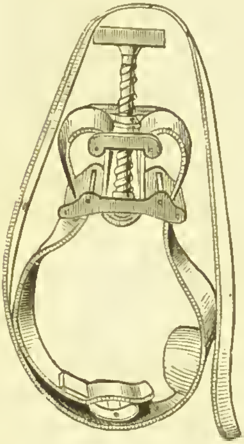

Fig. 27.—Petit's Tourniquet.

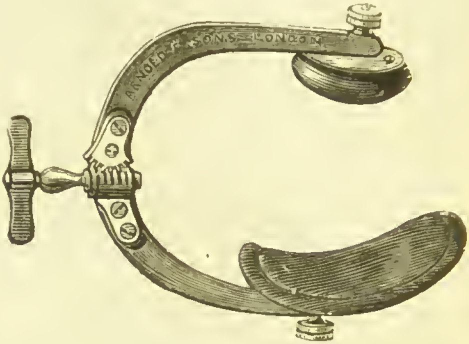

Fig. 28.—Signoroni's Tourniquet.

2. *Permanent methods.*—The agents employed for permanently arresting hæmorrhage are—1. *Cold*, 2. *Heat*, 3. *Pressure*, 4. *Styptics*, 5. *Cautery*, 6. *Ligature*, 7. *Torsion*, 8. *Acupressure*, 9. *Forcipressure*.

1. Cold is only applicable to stopping hæmorrhage from small vessels. It acts by causing the muscular coat to contract, and by promoting the coagulation of the blood. It is frequently employed in the form of cold water to arrest bleeding from the smaller vessels in operation wounds, and is a well-known domestic remedy for checking epistaxis, &c. Nasal haemorrhage

2. Heat in the form of hot water is now often employed in place of cold water in large operation wounds, as cold applied to a large surface tends to increase the shock of the operation. The water must be hot; warm

water merely encourages the hæmorrhage by washing away the coagula blocking the vessels. Heat, like cold, acts by stimulating the muscular fibres of the vessel to contract.

3. PRESSURE as a temporary means of arresting hæmorrhage has already been mentioned. Firmly applied to the flaps covering a wound, it is an efficient method of controlling the bleeding from the numerous small vessels necessarily divided in operations. In the form of a plug or tampon it is the best means at our command in certain situations where the artery cannot be secured by more reliable methods, as the rectum, vagina, tonsil, nose, socket of a tooth, interior of bone, &c. It is, moreover, frequently employed to stop hæmorrhage from a moderate-sized artery where such can be pressed against a bone, as in the scalp; whilst in the form of a graduated compress it is especially applicable to wounds of the palmar arch. Pressure acts mechanically by closing the vessel.

4. STYPTICS arrest hæmorrhage by inducing the coagulation of the blood. Those most in use are perchloride of iron, hamamelis, and nitrate of silver. Of the perchloride of iron, the strong liquor and the solid form are the most efficient preparations. Styptics may be most usefully employed in conjunction with pressure in cases where the latter alone has proved ineffectual. The objection to their use is that they are apt to cause inflammation and sloughing of the tissues, and consequently secondary hæmorrhage is liable to occur on the separation of the slough.

5. THE CAUTERY arrests bleeding in part by causing the muscular coat of the artery to contract, in part by inducing coagulation of the blood, and in part by charring the tissues and so producing an eschar which checks or prevents the flow of blood. The wound should be first dried by pressure with lint, and then immediately touched lightly with the cautery, which should be at a dull red heat, as, if used hotter than this, it simply destroys the tissue without producing the above effects, and the hæmorrhage continues. It may be applied in the form of the cautery-iron, which is simply heated in the fire; but Paquelin's benzoline cautery and the galvano-cautery are much more convenient. The chief objection to the use of the cautery is that it causes destruction of the tissues around, and on the separation of the resulting eschar secondary hæmorrhage is liable to ensue.

6. LIGATURE is the most reliable method of permanently arresting hæmorrhage, and is the one most frequently employed. Carbolized and chromicized catgut, carbolized silk, China twist, whipcord, kangaroo-tail-tendon, and ox-aorta are the materials chiefly used as ligatures. Of these good carbolized or chromicized catgut is perhaps the favourite, and answers admirably for securing the cut ends of arteries in amputation and other wounds. For the ligature of arteries, however, in their continuity the choice of ligature is still open to question, and will be referred to again under *ligature of arteries.* Whatever form of ligature is used it should not be too thick, or the internal and middle coats will be unevenly divided or may escape division altogether. At the same time it should be strong enough to resist absorption or softening till the artery is securely sealed. It should be tied tightly till the internal and middle coats are felt to yield, but not so tightly as to cut through the external coat. Recently Messrs. Ballance and Edmunds, as the result of an experimental enquiry on the ligature of the larger arteries in their continuity, have advocated that the ligature should be applied so as merely to occlude the lumen of the vessel, without dividing the internal and middle coats. These observations, however, can hardly apply to the ligature of the cut end of arteries in wounds, as unless the ligature is applied tightly to such there is, obviously, danger of its slipping. An artery is tied in an open wound by seizing the cut end with nibbed forceps (of which Fig. 29 is one of the best forms), drawing it gently from its sheath, throwing a ligature round it, and then tying the ligature in a reef-knot (Fig. 30, A). If aseptic material is used both ends are cut off short.

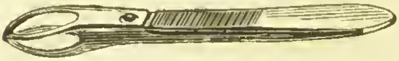

FIG. 29.—Luer's Artery forceps.

Effects of ligature.—When a ligature is properly applied the internal and middle coats are evenly and transversely cut through by its pressure. Their cut edges retract and curve within the canal of the vessel, and the external coat, crumpled up and tightly embraced by the ligature, retains the two inner coats in contact with each other

(Fig. 31). A clot of conical shape forms in the vessel, extending from the seat of ligature to the first collateral branch, and subsequently becomes adherent by its base to the wall of the vessel. The cut ends of the internal and middle coats unite by adhesive inflammation. When an animal ligature, such as catgut or kangaroo-tail-tendon, or a carbolized silk ligature with the ends cut short, is used, and the wound is kept aseptic, the ligature becomes embedded in the granulation tissue and absorbed, or, in the case of silk, encysted. Where one end of a silk ligature is left long and hanging out of the wound, as was commonly practised in former times, the external coat sloughs through where embraced by the ligature, allowing the latter to come away bringing the end of the artery round which it was tied with it. The permanent closure of the artery is accomplished by the process already described under *Nature's Method of controlling Hæmorrhage* (p. 115).

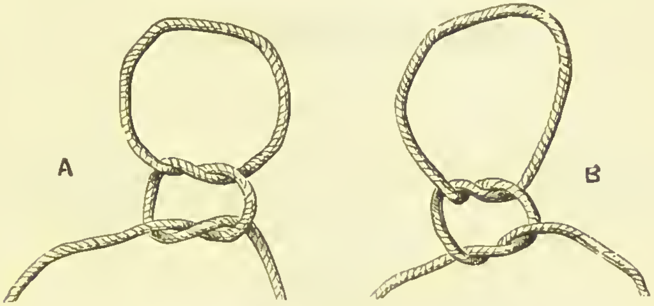

Fig. 30.—A. The reef-knot *versus* B. The granny knot.

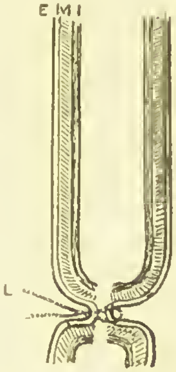

Fig. 31.—Diagram of a ligatured artery. E. External; M. Middle; and I. Interal coat. L. Ligature.

7. Torsion consists in seizing the artery firmly with the torsion-forceps (Fig. 32), drawing it gently from its sheath, and twisting it sharply several times in its long axis till the internal and middle coats are felt to yield. The process resembles the tearing across of an artery, such as occurs in the avulsion of a limb. When

torsion is successfully performed, the internal and middle coats are ruptured and bent upwards into the lumen of the artery, and the external coat is twisted up into a cone. A clot then forms, and the artery heals permanently in the way already described. It appears to be a reliable method, but takes a longer time in its performance than ligature.

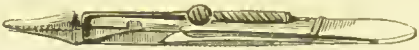

Fig. 32.—Torsion-forceps.

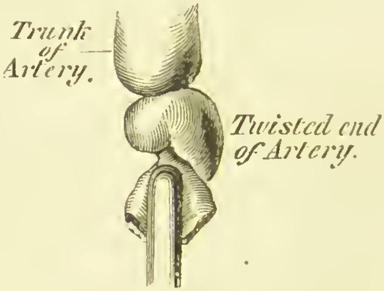

Fig. 33.—Effects of torsion on an artery. (Bryant's Surgery.)

V. Pick ligature

8. Acupressure consists in securing the end of the bleeding artery by pressing it between an acupressure needle (which resembles a hare-lip pin), and the tissues (Fig. 34, 1 and 2), or between the needle and a wire twisted over the needle (Fig. 34, 3). There are several methods of applying acupressure. That in common use in Aberdeen, the "Aberdeen twist" as it was called by Professor Pirrie (Fig. 34, 2), consists in transfixing the tissues with the needle parallel to the artery and close to its bleeding mouth (see dotted line Fig. 34, 2), and then giving the needle a quarter twist across the course of the artery and pressing its point for some distance into the tissues beyond. The artery is thus compressed between the needle and the tissues.

9. Forcipressure consists in seizing the bleeding artery, and the surrounding tissues if the vessel is small, with Spencer Wells' pressure forceps, leaving them on a few minutes and then very gently withdrawing them.

It is a means often used to control the hæmorrhage during an operation, and will even permanently arrest it in the case of the smaller vessels, which are often found not to bleed when the forceps are removed. It is sometimes employed for arresting hæmorrhage from a vessel which from its depth or other cause cannot be tied. In

3c/t tissue & needle 'aberdeen twist' [illegible]

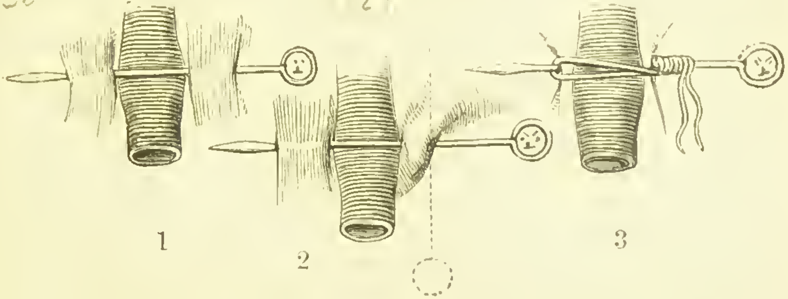

Fig. 34.—Different ways of applying acupressure. (Bryant's Surgery.)

such a case the forceps are left on from twelve to twenty-four hours, and at the end of that time are very gently removed so as not to re-start the bleeding.

2. Recurrent, reactionary, or intermediary hæmorrhage is that which may come on within the first twenty-four hours after a wound as the patient gets warm in bed, and the shock of the operation or injury has passed off. It may be regarded as a failure in the process of the temporary closure of the vessel. It should be noted that the term recurrent is by some authors applied to what is here termed secondary hæmorrhage. *Causes.*—1. Slipping of a ligature or displacement of a clot from a vessel consequent upon the wounded parts not being kept at rest. 2. Washing out of a clot from a vessel which it has temporarily plugged, by the increased force of the circulation as the heart regains power on the passing off of the syncope or shock. It is quite common in large wounds to have some oozing of blood through the dressings; but this should not be considered as recurrent hæmorrhage unless it occurs in unusual quantities, and only then calls for treatment. The soiled dressings having been sprinkled with iodoform, and covered with some form of antiseptic and absorbent material, the part should be firmly but gently bandaged and then

elevated. This failing, the dressings must be removed, and the flaps in the case of an amputation separated, the clots washed away with cold or hot water containing an antiseptic, and any vessel found bleeding, tied. The wound should be then redressed and firm pressure applied.

3. SECONDARY HÆMORRHAGE is that which occurs after the period of reaction has passed in consequence of the failure of the process for the permanent arrest of hæmorrhage.

Cause.—Secondary hæmorrhage is due either to the defective formation of the internal clot, or to the failure of union of the internal and middle coats. Either of these, again, may be (*a*) the result of some fault in the surgical means taken to arrest the primary hæmorrhage, and then in some measure may be said to be preventable; or (*b*) the result of some disease of the vessel or constitutional state of the patient, and then may usually be regarded as non-preventable. These causes may be considered under the following heads:—

1. *Defect in the ligature or in its application.*—(*a*) An improperly prepared animal ligature may become absorbed too soon. (*b*) A non-absorbable ligature, if chosen, may be too thick or tape-like, and hence not divide or unevenly divide the internal and middle coats. (*c*) The ligature may not be aseptic, and so cause suppurative instead of adhesive inflammation. (*d*) The ligature, whatever kind is used, may be tied too tightly or too loosely, or be unevenly knotted. (*e*) The sheath in applying the ligature may be too freely separated from the artery, or the artery bruised during the separation of the sheath. (*f*) The ligature may be placed too near a collateral branch.

2. *Defect in the management of the wound.*—The tissues may be roughly handled and bruised, or the wound may be imperfectly drained and the discharges allowed to become septic, so that, in either case, septic inflammation and suppuration may be set up and spread to the vessel and its contained clot.

3. *Disease of the vessel-walls.*—Under this head may be mentioned atheroma, calcareous degeneration, and syphilitic and tubercular disease, all of which may either allow the ligature too quickly to cut its way through the diseased coats, or prevent the adhesion of the internal and middle coats and the other changes that should occur in the normal process of healing.

4. *Constitutional conditions.*—These are such as render the blood less coagulable than usual, or are associated with an increase of the blood-pressure or an excited action of the heart. Amongst such conditions may be mentioned the hæmorrhagic diathesis, diabetes, Bright's disease, septicæmia, pyæmia, traumatic fever, and plethora.

Symptoms.—There may be a sudden and even fatal gush of blood, or previous to this, the discharges of the wound may have been blood-stained. In some cases, the bleeding may stop for a time, but again and even again recur till the patient finally sinks from exhaustion. Sometimes the hæmorrhage may cease spontaneously after one or more bleedings, and the patient recover.

Treatment.—A. *From an artery in a stump after operation.*—The treatment will differ according to (1) the date at which the hæmorrhage occurs; (2) whether it is from the main artery; (3) the condition of the stump; and (4) the situation of the amputation. Thus, when the hæmorrhage occurs *a few days* after the operation, and is little more than a mere oozing, elevation and pressure by careful bandaging will often stop it. If it should not do so, or the bleeding is more severe and appears to come from the main artery, a tourniquet applied to the artery above may succeed. This failing, or the flaps appearing distended with blood, they should be opened up, the clots removed, and the bleeding vessels secured. At a *later period*, when the healing process has considerably progressed, should pressure fail, it becomes a question whether the healing flaps should be torn apart and the artery secured at its bleeding point, whether the main artery should be tied above the wound, or whether re-amputation should be performed. If the main artery can be easily secured just above the operation wound, this is to my mind the proper procedure, especially if the wound is in a sloughy condition, in which case the ligature would probably not hold at the seat of bleeding. This is also the right course to pursue if the amputation has been performed at the shoulder or hip-joint; but if in the lower third of the leg or in the fore-arm, then an attempt should be made to tie at the wound, or if this is impossible from the sloughy condition of the stump, re-amputation is probably the safest treatment.

B. *From an artery in its continuity.*—Pressure should first be applied at the seat of wound, and in the case of one of the extremities for a considerable distance over the course of the artery, both above and below the wound, and the whole limb bandaged from the foot or hand, as the case may be, upwards. This treatment failing after a thorough trial of it has been made, the best plan, as a rule, is to cut down upon and tie both ends of the bleeding artery in the wound. Tying the main artery at a distance above the wound has been advised, but is open to the objection that the secondary bleeding often comes from the distal end of the artery; and that even when it comes from the proximal end, the ligature of the main vessel may not control it, since blood may be carried into the artery below the ligature by collateral branches (see Fig. 40, p. 190). Further, in the case of the lower extremity, there is also a danger of gangrene. The operation of tying at the seat of wound is no doubt difficult, as the parts are generally matted together or in a sloughy condition, and the coats of the artery so softened that a ligature will not hold; but by following the artery a little way upwards and downwards, a healthy portion may be found whereon to place the ligature. The steps of the operation are greatly facilitated by the use of Esmarch's bandage. Where the hæmorrhage comes from an artery deeply placed, as the external iliac or subclavian, pressure is probably our only resource. In the case of the iliac, an attempt might be made to eat secure it at the e~~sat~~ of bleeding. In the only instance, however, in which I have seen it tried, it was unsuccessful. Should hæmorrhage recur after both ends of the artery have been tied at the seat of wound, amputation in the case of the lower extremity is probably the safest course.

VENOUS HÆMORRHAGE.—When a vein is cut completely across, the arrest of hæmorrhage is due chiefly to the formation of a coagulum in its interior, but partly to the collapse of the vein. *Treatment.*—Unless a large vein is wounded in its continuity, no treatment beyond pressure is usually required. Should the main vein bleed after an amputation a ligature should be applied to it. See *treatment of wounded veins.*

CAPILLARY HÆMORRHAGE is arrested by the formation of coagula in the capillaries and smaller arterioles. The coagulation is due in part to the exposure of the blood to the air; in part to the traumatic inflammation set up in the capillary-wall during its division; and in part to the diminished force of the circulation in the capillaries consequent upon the reflex contraction or even closure of the arterioles which follows the division of the tissues.

Treatment.—As the hæmorrhage usually stops spontaneously, nothing in the way of treatment is, as a rule, called for. Cold or hot water, however, may be used to more quickly cause its cessation; and firm pressure on bringing the wound together will also check it.

CONSTITUTIONAL EFFECTS OF INJURY.

cf. **Shock** is a general lowering of the vital powers induced by a severe impression made directly on the nerve-centres, or indirectly through the peripheral nerves.

The *causes* of shock may be divided into the predisposing and the exciting. Certain conditions prior to an injury or an operation tend to make the shock more severe, and may therefore be regarded as *predisposing* causes. Such are Bright's disease, hepatic and cardiac mischief, a highly nervous and hysterical temperament, enfeeblement from old age, sedentary occupation, excessive fear of the operation, &c. Among the *exciting* causes may be mentioned mechanical injuries, especially of important parts or organs, as the abdomen, testicle, &c., burns and scalds, especially when extensive and involving the trunk, serious operations particularly when prolonged, undue exposure of the body to cold as during a long operation, bites of venomous reptiles, the action of some irritant poisons, the sudden emptying of an over-distended bladder, &c. Powerful mental emotions, as sudden fright, grief, or joy, are sometimes sufficient of themselves to produce severe and even fatal shock. In fatal cases of shock, however, from such causes, some visceral disease has generally been discovered. Fright, moreover, adds to the shock produced by mechanical injury, as seen for example in railway accidents, burns from the clothes taking fire, &c.

Pathology.—But little is found *post mortem* in fatal cases of shock. The right side of the heart and the venous system generally, especially the abdominal veins, may be engorged with blood, and the nerve-centres anæmic. Sometimes the heart has been found empty, and if the shock has been combined with severe hæmorrhage there may be a general deficiency of blood in the body. The impression produced by the injury, operation, or mental emotion on the nervous centres, is believed either—1, to lead to paralysis of the heart directly through the pneumogastric nerves; or 2, to induce through the splanchnics a vaso-motor paralysis of the walls of the abdominal veins, whereby they become engorged, and the nerve-centres and heart in consequence imperfectly supplied with blood; hence, partly owing to deficient nervous stimulus, and partly to lack of sufficient arterial blood to the heart's substance and ganglia, cardiac paralysis ensues.

The *symptoms* vary considerably in severity. In extreme cases the patient lies in a semi-conscious state. His pulse is feeble, frequent, and fluttering, perhaps hardly perceptible at the wrist. The surface, especially that of the extremities, is cold, the temperature falling at times to 97°, or even 96°; the face is pale; the lips are blanched; the skin is moist or covered with a clammy sweat; the eye is half closed, and lustreless or glazed; and the respiration is shallow, and may be barely perceptible. There is marked muscular relaxation; there may be yielding of the sphincters, and at times nausea and vomiting. The symptoms may gradually increase, and the patient die of syncope or asthenia; or he may gradually rally and pass into the condition known as *reaction*. The pulse will then become full and increased in frequency, the temperature slightly raised, the face flushed, the skin hot and dry, the urine scanty and high coloured, the tongue furred, and the bowels confined. Many of the feverish symptoms, however, that were formerly regarded as the result of excessive reaction, are now known to be due to septic poisoning.

Treatment.—In slight cases, beyond covering the patient up warmly in bed with blankets, and applying hot bottles to the feet, nothing is required, except when there is much pain a subcutaneous injection of one-sixth to one quarter of a grain of morphia. In severe cases, small and repeated doses of brandy should be given, carefully watching its effect upon the pulse so as not to subsequently induce excessive reaction; whilst hot bottles should not only be applied to the feet, but placed on either side of the thorax, and friction used to the hands and surface generally. If there has been severe hæmorrhage, fluid nourishment in small and oft-repeated doses should be administered with the stimulant. In extreme cases,

failure of power of the heart

where the patient is unable to swallow, brandy should be administered by the rectum or ether injected subcutaneously; whilst, should the breathing cease, artificial respiration ought to be employed and persevered in for some time, although at first it may apparently be ineffectual. The application of heat by means of hot bottles and warm blankets must, in the meantime, on no account be neglected. Hot flannels placed over the cardiac region may be successful in rousing the flagging heart; and in the case of a child, a hot bath may be given. Should the jugular veins be distended, indicating an over-full and partially-paralysed condition of the right side of the heart, the external jugular vein may be opened. On the other hand, if there has been excessive hæmorrhage, transfusion should be performed, the extremities in the meantime being raised and bandaged so as to impel as much blood as possible to the nerve-centres and imperfectly-distended heart. Electricity in some cases has been useful.

TRAUMATIC FEVER.—After every injury, when severe, the temperature, even when there is no wound, rises one or two degrees, but falls to normal about the third day, whilst the tongue may become slightly furred, the bowels confined, the appetite lost, and the pulse increased in frequency. These symptoms, however, pass off with the fall of temperature, and, for the rest of the period while the wound is healing, the patient's general functions are performed naturally. This condition appears to depend in part upon an impression made through the peripheral nerves on the heat-regulating centre in the medulla, and in part upon the absorption of free fibrin ferment which escapes with the leucocytes and serum in the process of the simple traumatic inflammation resulting from the injury. This *simple form of traumatic* fever must be carefully distinguished from the *septic*, which depends on the absorption of the products of putrefaction from a septic and imperfectly drained wound. If the wound is allowed to become septic, the symptoms of simple traumatic fever pass into those of the septic form, or if the dose of poison absorbed has been large, into those of sapræmia. Simple traumatic fever subsides of itself, and requires no special treatment beyond relieving the bowels by a gentle purgative and keeping the patient on slop diet. *Septic traumatic fever* will be described under septic processes in wounds.

TRAUMATIC DELIRIUM is the term applied to the delirious state which sometimes supervenes after injuries and surgical operations. The delirium may depend upon several distinct conditions. Thus (1.) it may be merely a symptom of septic traumatic fever, and is then known as *inflammatory* or *septic traumatic delirium.* (2.) It may occur in the highly nervous or neurotic as the result of severe mental strain or exhausting brain-work previous to the injury or operation, being then spoken of as *nervous traumatic delirium.* (3.) It may be the result of the long-continued abuse of alcohol, and is then ordinary *delirium tremens* brought on by the accident or operation. These various forms, however, no doubt often occur together.

Inflammatory traumatic delirium.—Of this variety little need be said further than it generally occurs from the third to the fifth day when the septic traumatic fever is at its height, and that it usually begins or is worse in the night and abates with the morning remission of temperature. The *treatment* is that of septic traumatic fever with the addition of an ice-cap to the head when the delirium is high.

Nervous traumatic delirium, though rare, sometimes occurs in subjects of a susceptible nervous temperament or over-exhausted with brain-work. It is unaccompanied by fever and closely resembles delirium tremens, except that it is not due to alcoholism. The delirium, which is usually of a low and muttering, but occasionally of a violent or maniacal character, usually yields to quiet and opium, or bromide of potassium and chloral, with careful feeding and the judicious employment of stimulants where such are indicated.

Alcoholic traumatic delirium or delirium tremens differs from the inflammatory variety in the absence of fever, and in the peculiar nature of the delirium, which is of a low muttering or busy kind. The patient has delusions, fancies that he sees animals or devils under his bed or chair, is suspicious of his friends, talks constantly to himself, answers rationally when spoken to, but immediately relapses into his incoherent muttering state. Sometimes the delirium is of a violent character, the patient will not remain in bed, and may attempt to destroy himself or those around him. The temperature is normal or but slightly raised; the skin is perspiring; the hands are tremulous; the pulse is full, soft, and often quickened; the tongue is also tremulous, indented by the teeth, and coated with a creamy fur, and in severe cases becomes dry and brown. The bowels are usually confined. The patient cannot sleep, and will not of his own accord take food, but will, as a rule, drink anything.

The *prognosis* is good when the patient is young and can be induced to take food; but when he is broken-down in health or the subject of visceral disease he usually sinks into a state of asthenia, and dies of exhaustion, or it may be of heart-failure during a paroxysm of violence.

Treatment.—The chief indications are to make the patient take food and to procure sleep, and so restore power to the exhausted nerve-centres. Thus, the digestive functions should be regulated by clearing the bowels with a purgative or an enema, and by the subsequent administration of tonics, such as quinine. The difficulty in getting the patient to take food may generally be overcome by a judicious mixture of firmness and coaxing, otherwise he must be fed by an œsophageal tube. The diet should consist of fluid nourishment given in small and repeated quantities by night as well as by day, provided the patient is awake. To procure sleep subcutaneous injections of morphia (gr. $\frac{1}{6}$ to $\frac{1}{4}$), or bromide of potassium and chloral in doses of twenty grains of the former to fifteen of the latter, should be given every two hours, carefully watching their effect. When these fail, success may sometimes be obtained by first inducing insensibility by chloroform, and following up its effects by the subcutaneous injection of morphia. The administration of chloroform to patients with delirium tremens is however by no means free from danger, since three deaths have occurred at St. Bartholomew's alone in seven years. If there is kidney disease, morphia and opium should not be given at all, or with great caution. The question of the administration of stimulants is one on which surgeons differ. Perhaps the best rule is—where the patient is young and of good constitution, to withhold them entirely; but where he is old, broken down in health, or the subject of visceral disease, to give them in moderate quantities, regulating the dose according to the amount of depression and the effects produced. If he is violent or noisy he must be placed in an isolation-ward, and prevented from injuring himself or his attendants, either by the use of the strait-jacket or by manual restraint. Seclusion itself has often a good effect in producing sleep. The management of a local injury is often rendered very difficult by the patient tearing off bandages, splints, &c., and thus, for example, converting a simple fracture into a compound one. Such mischief can only be prevented by the greatest watchfulness and care.

DISEASES THE RESULT OF SEPTIC AND INFECTIVE PROCESSES IN WOUNDS.

The diseases included under this head may be divided into two chief classes, the *septic* and the *infective.*

I. The SEPTIC are such as depend upon putrefaction or fermentation, whereby certain chemical products, known collectively as ptomaines, are formed and set up local inflammation and suppuration, and if absorbed into the system through the blood or lymph channels, give rise to fever and other constitutional symptoms known as blood-poisoning. These chemical products are believed to be of the nature of alkaloids, and to act on the tissues locally, or on the whole system if absorbed, as intense irritants, and in a manner similar to that in which known alkaloidal bodies do. Thus, they do not multiply in the body, and the effects to which they give rise are proportionate to the dose absorbed; and as soon as the putrefactive or the fermentative processes in the wound, or the absorption of their products, is prevented, the local inflammation and the constitutional symptoms cease. The poison is non-infective: that is, if an animal is inoculated with the blood of another suffering from a septic disease, the disease is not transmitted. Neither is there evidence of one patient being able to infect another. Micro-organisms are not discovered in the blood or tissues during life, nor immediately after death.

II. The INFECTIVE diseases are believed to depend upon inoculation by some specific virus, which is generally thought to be of the nature of micro-organisms, or of an unorganised ferment produced by them in some at present unknown way. In this class, the poison, whatever its nature, is believed to thrive and multiply in the tissues or blood; the effects produced, therefore, are not proportionate to the dose, the smallest quantity introduced into the system being sufficient after a certain incubative period, during which the poison is multiplying, to set up local or constitutional effects. The poison is infective; that is, the disease can be transmitted from animal to animal by the blood, and there is strong evidence, conclusive in some forms of infective diseases, that the infection is capable of being conveyed from patient to patient. Micro-organisms in large numbers are found in the blood and in the tissues immediately after death.

Both septic and infective diseases may occur simultaneously in the same subject; thus, a specific virus may set up a localized infective inflammation in the wound, and the septic products of this may be absorbed into the system either with or without the specific virus.

These diseases, whether *septic* or *infective*, may be divided into the local and the general: that is, the poison may set up local mischief, which may or may not be followed by general poisoning of the system; or the whole system may be primarily affected, any local mischief that may occur in the wound being merely of secondary consequence.

Septic

To take the *septic diseases* first, or those due to putrefaction or to fermentation. As a *local affection* there is *Septic inflammation*, a spreading inflammation attended with suppuration and due to the local irritation of the chemical products formed by the putrefaction or fermentation of the discharges in an imperfectly drained or unprotected wound (see p. 11). As *general affections* there are, —1. *Septic traumatic fever*, a general disease produced by the absorption of a moderate dose of the chemical products of putrefaction or fermentation from a septic wound. 2. *Hectic fever*, a constitutional condition attending prolonged suppuration, and probably induced by the continued absorption of the septic poison in small quantities at a time. 3. *Sapræmia or septic intoxication*, a severe and often rapidly fatal form of blood-poisoning due to the absorption of a large dose of the septic poison, and therefore to be regarded as a more intense form of septic traumatic fever, the difference being one of degree rather than of kind.

cal

eral

The *infective diseases*, or those depending upon micro-organisms, may be similarly divided into the local and the general. The *local* are, 1. *Traumatic erysipelas*, an acute infective spreading inflammation secondarily affecting the system, and probably due to inoculation of the wound with the micrococcus erysipelatosus. 2. *Cellular erysipelas* or *diffuse cellulitis*, a spreading inflammation of the connective tissue, probably due to inoculation with several different forms of micro-organisms. 3. *Spreading traumatic gangrene*, a rapidly-spreading inflammation invariably terminating in gangrene, and probably due to inoculation with a specific bacillus. 4. *Hospital gangrene*, a form of rapidly-spreading gangrene attacking wounds in overcrowded and unhealthy hospitals, and probably due to a species of micrococcus. 5. *Wound-diphtheria*, a condition in which a granulating wound becomes covered with a false membrane resembling that of diphtheria, probably also depending upon the presence of a specific micrococcus. 6. *Malignant pustule*, due to the inoculation of a scratch or abrasion with the anthrax bacillus. The *general affections* may be enumerated as : 1. *Septicæmia* or *septic infection*, a form of blood-poisoning in which the poison, probably a micro-organism, rapidly multiplies in the body, but distinguished from pyæmia by the absence of secondary abscesses. 2. *Pyæmia*, also a form of blood-poisoning, probably in many instances due to a micro-organism that slowly multiplies in the body. It comes on usually in the course of a wound which is suppurating, and is attended with secondary abscesses. 3. *Glanders*, an infective disease, due to inoculation with a specific form of bacillus derived from a similar disease in the horse. 4. *Hydrophobia*, a general disease depending upon a specific virus introduced into the system through the medium of the saliva of the dog. 5. *Tetanus*, a general disease, believed by many to depend upon the presence of a specific bacillus, but by others to be due to a nerve lesion.

Septic inflammation, hectic fever and spreading traumatic gangrene have already been described. The rest of the general septic and of the local and general infective diseases, including tetanus, will now receive mention.

General Septic Diseases.

Septic traumatic fever is the result of the absorption of the chemical products of putrefaction or decomposition from a septic or imperfectly-drained wound (see *septic inflammation*). It begins usually about the second or third day after the wound, whether this be the result of injury or of operation, with a feeling of chilliness or a distinct rigor. The temperature runs up to 102° or 103° or higher, with morning remissions, the pulse is increased in frequency, the skin is hot and dry, the urine is scanty and high coloured, the tongue is furred, the appetite is lost, the bowels are confined, and the patient complains of headache and general feeling of malaise, and is at times delirious. The symptoms, which are generally at their height about the sixth or seventh day, may subside as suppuration is established and the further absorption of septic products is prevented by the sealing of the tissues with the inflammatory exudation and the formation of granulation tissue. If the absorption of septic products continues in small quantities the fever may run on into hectic, or, if the dose of poison is increased, into sapræmia. The *treatment* consists in at once rendering the wound aseptic and thoroughly draining it, the bowels in the meantime being opened by a brisk purge, and slop diet continued.

SAPRÆMIA OR SEPTIC INTOXICATION, which has hitherto been included with septic infection under the term septicæmia, is a form of blood-poisoning believed to be due to the absorption of the chemical products of putrefaction (*sepsin*) derived from a septic or ill-drained wound. Clinically, it is not always possible to distinguish it from septicæmia nor from pyæmia before metastatic abscesses are formed; and it is probable, moreover, that sapræmia, septicæmia and pyæmia, though each may depend upon a different poison, often occur simultaneously in the same subject.

Cause.—For sapræmia to occur the septic poison must be absorbed in a sufficient quantity, which is estimated in the human subject at from one to two ounces. Hence the cause may be said to be those conditions that lead to the production of the poison in large quantities and that favour its absorption into the blood. Amongst these may be mentioned—1. Extensive wounds recently made, inefficiently drained, and not kept aseptic. 2. Wounds of serous and synovial membranes. 3. Abscesses, cavities, and granulating wounds in which decomposing discharges are subjected to mechanical tension in consequence of the insufficiency of the external opening.

Pathology.—The poison, notwithstanding its virulence, is productive of very little in the way of *post-mortem* change which can be said to be characteristic. The parts on which its effects are more especially manifested are the blood, the gastro-intestinal canal, the nerve-centres, and the kidneys. Thus, the red blood-corpuscles undergo rapid disintegration, causing a staining of the tissues and vessels, and are found aggregated in little masses blocking the capillaries, and, probably in consequence, producing the capillary hæmorrhages (*petechiæ*) which are found more or less over the whole body, and especially beneath the serous membranes. No micro-organisms are found in the blood. The gastro-intestinal canal, the nerve centres, and the viscera generally are congested; the congestion of the kidneys, by which organs the poison is principally eliminated, being especially marked. Decomposition occurs very rapidly after death.

The *Symptoms*, of which headache, vomiting, and delirium are the chief, usually come on about the second day after the infliction of the wound, and may be ushered in by a slight chill or even a severe rigor. The temperature suddenly rises to 103° or 104°; the skin becomes clammy; the tongue dry and furred; nausea or vomiting, and sometimes diarrhœa set in; the patient becomes delirious, and if the dose of the poison has been large or its continuous absorption is not prevented, rapidly sinks into a state of collapse; the temperature falls below normal, he becomes unconscious, then comatose, and then dies. Where the dose absorbed has been less, the progress of the disease is less rapid, the patient becomes anæmic, and perhaps jaundiced, the urine albuminous, the spleen enlarged, the vomiting and diarrhœa continue, and death may occur from exhaustion.

The *treatment* must be directed to the removal of the decomposing discharges from the wound or cavity. If this is promptly and effectually done, the disease will generally be arrested. Thus, wounds must be washed out with antiseptic lotions, serous cavities drained, joints laid freely open, and tension in abscesses removed by giving free vent to the pus. The patient's strength in the meanwhile must be supported by fluid nourishment and the judicious administration of stimulants, and the subsequent anæmia combated by iron and quinine.

Local Infective Diseases.

Erysipelas is an infective, diffusely spreading inflammation, commonly affecting the skin or subcutaneous tissue, or both, less frequently the mucous membranes or submucous tissue, and still more rarely the serous membranes and the connective tissue in such situations as the pelvis, orbit, &c.

Cause.—Erysipelas depends upon the introduction of an infective poison into the system; but for this to act it appears to be necessary that the vitality of the body should be lowered, and the tissues in consequence rendered less able to resist the injurious influence of the poison. The causes, therefore, may be divided into the predisposing and the exciting, the predisposing again into those that are general and those that are local.

The general predisposing causes are such as pertain either to (*a*) the state of nutrition of the body, or (*b*) its environment. (*a*). Among the conditions that predispose to the disease by inducing an impaired state of the tissues are —1, chronic alcoholism; 2, Bright's disease; 3, diabetes; 4, gout; 5, malignant disease; 6, insufficient food; 7, want of exercise combined with high living; 8, previous attacks of the disease. (*b*). Among the causes that pertain to the environment of the body are bad hygienic conditions of all kinds, as—1, imperfect ventilation; 2, defective drains; 3, accumulation of the products of decomposing organic matter; 4, overcrowding; 5, want of cleanliness; 6, a large number of suppurating wounds in an hospital; and, 7, probably certain not altogether understood atmospheric influences. *The local predisposing cause* is the presence of a wound, scratch, or abrasion of the surface, and especially of a lacerated wound, or one in which the discharge is undergoing putrefaction.

The *exciting* cause is the introduction of some infective poison into the system. This poison is probably not the same in each form of the disease. In the cutaneous form it would appear from the observations of Fehleisen, to be a species of micrococcus. It had been known for some time that micrococci existed in the spreading margin of cutaneous erysipelas. Fehleisen cultivated some micrococci from this source, in some instances through thirty generations, *i.e.*, for upwards of six months, and then inoculated several patients, in all of whom, with the exception of one, who had just recovered from an attack of the disease, erysipelas, after an incubation period of from 15 to 60 hours, was set up.* The contagion may be conveyed by the hands of the surgeon or nurse, by instruments, sponges, &c., and probably by air and water. It is now supposed to enter the system in all cases through a wound. The so-called idiopathic erysipelas, in which there is ostensibly no wound, was thought to be an exception, but as this invariably occurs on exposed parts, as the face, it is now believed that the poison gains access through some slight crack or abrasion that has been overlooked.

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* These inoculations were undertaken for the cure of lupus and malignant tumours, and in two instances apparently with success.

Pathology.—The virus, when inoculated, multiples in tho tissues, and spreads by the lymphatic vessels and spaces, and after passing through the lymphatic glands, which become swollen and tender, enters the system, producing the constitutional symptoms. Locally, the inflamed tissues present the ordinary signs of inflammation, the vessels aro dilated, and the parts infiltrated with serum and leucocytes. In the cutaneous form the micrococci are only found at the spreading margins of the inflammation, not where it is fading or has passed away. When the cellular tissue is also involved, suppuration generally occurs, and the vessels which run through it to the skin are destroyed, and the skin in consequence sloughs. The general appearance of the body is similar to that seen in other cases of septic poisoning. The organs are congested, and the blood is thin and fluid. The micrococci are not, as a rule, found in the blood; but the white corpuscles have been observed degenerated, and in some instances forming granular masses, plugging the capillaries of the lungs and brain.

VARIETIES.—Erysipelas may be divided into—1, the cutaneous or simple; 2, the cellulo-cutaneous or phlegmonous; and 3, the cellular, or diffuse cellulitis.

1. CUTANEOUS OR SIMPLE ERYSIPELAS generally attacks the skin, less commonly the mucous membrane. The symptoms are *local* and *constitutional.*

Local signs.—There is a vivid blush of redness, usually, but not invariably, starting from a wound, and appearing either simultaneously with, or in some instances not till twenty-four to forty-eight hours after the onset of the constitutional symptoms. The blush has a great tendency to spread, or to suddenly leave one part and attack another (*metastasis*). The spreading edge is sharply defined and slightly raised above the surrounding skin, whilst the subsiding edge fades off into the healthy skin. The surface is usually at first vividly and uniformly red, œdematous, and shining, the redness fading momentarily on pressure, and later becoming of a dusky hue. The patient complains of a stiffness and stinging heat in the part. In very acute cases the cuticle is raised into blebs by the exudation of serous fluid beneath it, and the nearest lymphatic glands are generally tender and enlarged. Where the tissues are lax, as about the face or scrotum, there is much œdema, but there is little tendency to suppuration. When the inflammation subsides, there is usually some desquamation of the cuticle.

The *wound* itself, if one is present, takes on an unhealthy appearance; it ceases to heal, the edges swell, the granulations shrivel and the surface becomes dry.

The constitutional symptoms generally begin with a chill or rigor. The temperature suddenly rises to 103° or 104°, or higher, but it does not fluctuate as in septicæmia and pyæmia. The pulse becomes rapid, and there is headache, furred tongue, constipation, and sometimes diarrhœa.

Terminations.—The erysipelas as a rule gradually subsides, and the patient recovers; or it may spread over a large area, and the patient sink into a low typhoid state, and die of blood-poisoning, especially when the subject of kidney disease or other visceral trouble. When about the head and face it may spread to the pharynx, and thence to the larynx and end fatally from œdematous laryngitis; or it may attack the membranes of the brain and set up meningitis. Relapses are common.

Treatment.—The bowels should be opened by a smart purge, and subsequently perchloride of iron given in large doses. Slop diet is usually required at first, but as the constitutional symptoms generally assume a low type, the patient should not be too much depressed, as a stimulating plan of treatment will probably sooner or later be indicated. Thus, ammonia and bark, brandy and egg mixture, brandy, strong beef-tea, &c., are called for should the temperature run high, the pulse become soft, and the tongue dry and brown, or low muttering delirium set in. Locally, nothing answers better than dusting the part with equal quantities of oxide of zinc and starch powder, and enclosing it in a thick layer of cotton-wool. When there is an unhealthy wound, means should be taken to render this aseptic; but strong antiseptics, as carbolic acid, must be avoided, as they cause too much irritation. Should there be any collection of pus, or other pent-up discharge, it must of course be let out, and the part efficiently drained. When a patient is attacked with erysipelas in an hospital, he should be removed to an isolation ward, and the greatest care taken not to infect other patients.

2. CELLULO-CUTANEOUS, OR PHLEGMONOUS ERYSIPELAS, differs from the preceding variety, in that it involves the subcutaneous tissue as well as the skin. It has not been proved to be inoculable, and probably depends upon a poison different to that setting up the cutaneous form. It is probably always associated with a scratch or wound, and nearly always terminates in suppuration of the subcutaneous tissue and sloughing of the skin, but it seldom penetrates beyond the deep fascia unless this has been injured. It is most common in the intemperate, or those of broken-down constitution or the subject of visceral disease, and is especially frequent after a scalp wound.

Symptoms.—There is locally much more œdema and swelling than in the former variety, the redness is less bright, and not so sharply defined, and blebs or bullæ containing serum, which may be blood-stained, often form over the affected part. The pain, at first hot and tingling, soon becomes throbbing, and the swelling brawny, and, should suppuration occur, boggy in places; whilst the redness assumes first a dusky, then a purple, and then a mottled hue; finally dark-coloured sloughs form, but no pointing occurs. If an incision is made into the tissues, they are at first found infiltrated with fluid, and later look like wet wash-leather from the breaking down of the cellular tissue into pus and sloughs. As the inflammation is more intense than in cutaneous erysipelas, so are the constitutional symptoms, though similar, more severe. The fever, at first slight, assumes a typhoid character as suppuration sets in. After the skin gives way septic bacteria may enter, and blood-poisoning be set up. The disease may *terminate* in resolution, but more frequently runs the course above described, and may end fatally from broncho-pneumonia, sapræmia, septicæmia, pyæmia, exhaustion, or hectic. It is most fatal when, as is so frequently the case, the patient is the subject of chronic kidney disease. Locally, it may lead to necrosis of bone, destruction of a joint, brawny thickening of the part, or much scarring.

Treatment.—This must be both constitutional and local. A purgative should be given at the onset, and the patient placed on slop diet, which should be exchanged, when suppuration occurs, for concentrated nourishment with bark, iron, and stimulants. Locally, hot fomentations or linseed-meal poultices may be applied before suppuration has occurred, provided there be no wound. In the latter case, warm antiseptic dressings must be substituted for the poultices. Incisions, however, should be made early before sloughing has had time to take place, *i.e.*, as soon as the parts become brawny. A number of small incisions made parallel to the long axis of the limb are preferable to one long one. They should extend through the skin into the inflamed cellular tissue, the hæmorrhage, which is often free, being readily stopped if excessive by plugging with iodoform or sal alembroth gauze, or like antiseptic material. Subsequently the wounds should be dressed antiseptically, well drained, and the sloughs removed from time to time as they form. At St. Bartholomew's Hospital a large charcoal poultice is a favourite form of dressing. Should diarrhœa set in it may be controlled by opium; but this drug must be given cautiously when there is kidney mischief. In bad cases, where much skin has been destroyed or a joint irreparably damaged, amputation may ultimately be required, but should not, as a rule, be done whilst the disease is in progress.

3. CELLULAR ERYSIPELAS, OR DIFFUSE CELLULITIS, is an acute, infective, and diffuse inflammation of the cellular tissue. It may occur in the subcutaneous or submucous tissues, in the intermuscular planes, in the cellular tissue of the pelvis or orbit, in fact anywhere in the body where cellular tissue exists. It is probable that it does not always depend upon the same specific virus, and hence, although it spreads by the lymphatics and lymph spaces like cutaneous erysipelas, it is not like it a definite infective disease. It may be due to various causes. Thus it may occur in the subcutaneous tissue after a scratch or puncture, particularly one inflicted in the *post-mortem* room or by the bite of a venomous reptile or sting of an insect; in the pelvic cellular tissue after parturition, or the operation of lithotomy; and in the submucous tissue after an injury, as a sting of the throat by a wasp.

Symptoms.—The constitutional symptoms resemble those already given under the preceding varieties of erysipelas, and though they may vary in intensity they are generally grave and soon assume an asthenic type, and become those of sapræmia as the septic products are absorbed from the decomposing sloughs. The local symptoms vary according to the part attacked. When the subcutaneous tissue is affected they are similar to those of cellulo-cutaneous erysipelas, save that the skin is not at first involved but is only slightly reddened or mottled; the parts, however, feel hard and brawny, and become boggy as suppuration occurs. Later, the skin, as the vessels which supply it are destroyed by the pressure of the inflammatory exudation in the subcutaneous tissue, loses its vitality and rapidly becomes gangrenous and sloughs. The signs of cellulitis of the pelvis, neck, &c., will be referred to in dealing with the diseases of special regions (see also *Dissection Wounds*).

The *Treatment* is like that of cellulo-cutaneous erysipelas. Incisions should be made early, and stimulating treatment is generally required from the first.

HOSPITAL GANGRENE OR SLOUGHING PHAGEDÆNA is a rapidly spreading, infective inflammation accompanied by extensive sloughing and ulceration. It most commonly affects an open wound, but has been known to follow injuries where there has been no break in the skin. It is seldom seen at the present day owing to improved hygiene, better hospital management, and the more scientific treatment of wounds. The specific virus, probably a definite form of micrococcus, may be conveyed to the wound by the air, the hands of the Surgeon or nurse, instruments, sponges, &c. The micrococci are found in chains and masses as well as singly, both in the slough and in the inflamed tissues around. (See also *Phagedœnic Ulcers*, p. 31.)

Symptoms.—When an open wound is attacked a pultaceous, ash-grey, adherent slough forms on the surface, and the sloughing rapidly spreads both deeply and widely. The edges of the wound are dusky-red, œdematous, sharp-cut, and rapidly melt away as the gangrene proceeds. The discharge is thin and greenish or blood-stained, and exhales a horrible fœtor. Although a local infective disease, severe constitutional symptoms of blood-poisoning, rapidly assuming a typhoid character, are set up by the absorption of the septic products, and frequently terminate fatally in a few hours. No micro-organisms have been found in the blood.

Treatment.—The patient should be isolated, and where the disease occurs in military practice as an epidemic, the whole of the patients in the infected building should be removed to huts or tents. Stimulants, opium, and quinine should be given internally; whilst locally, the slough must be completely removed, the ulcerated surface thoroughly destroyed by strong nitric acid or chloride of zinc, and the wound sprinkled with iodoform and dressed antiseptically.

WOUND-DIPHTHERIA is rare in this country. It is thought by some to be a mild form of hospital gangrene, by others to be a distinct affection depending upon a specific form of micrococcus and the result of bad hygiene and want of cleanliness in the treatment of the wound. When a wound is so attacked, the surface, previously granulating, becomes covered with a greyish-white, opaque, tenacious membrane, similar to that of diphtheria. This membrane consists of granulation-cells and coagulated exudation, in which are found micrococci in chains and colonies. The affection appears to be only very slightly contagious, and does not affect the system generally further than by the absorption of the septic products. The *treatment* consists in attention to the general hygiene, and dusting the wound with iodoform or rubbing it over with a stick of nitrate of silver.

MALIGNANT PUSTULE or CHARBON is a specific and infective disease due to inoculation with a virus (the *bacillus anthracis*) obtained from animals suffering from splenic fever. It occurs most frequently in this country amongst those whose work brings them into contact with hides imported from countries in which splenic fever is common. The bacillus may enter the system through a wound or abrasion of the skin, a pustule occurring at the point of inoculation. The disease may then remain localized, or the bacillus may enter the blood and there rapidly multiplying give rise to constitutional symptoms. At times the bacillus is absorbed directly into the blood through the alimentary or respiratory mucous membrane without any external manifestation, and sets up similar constitutional symptoms, the affection being then known as *Woolsorter's Disease.* (See a work on Medicine.)

Symptoms.—A red itching pimple is first noticed, generally at the situation of a slight scratch or abrasion of the skin, on the face or some other exposed part. The pimple soon becomes converted into a vesicle, whilst the surrounding tissues become red and brawny. Gangrene occurs at the focus of inflammation, and around this a ring of secondary vesicles forms. Thus, when the so-called pustule is fully developed, it presents a very characteristic appearance. In the centre there is a dry black slough, around this a ring of vesicles, and around this again an area of redness, brawny induration and much œdema. There is, however, but little pain and no suppuration. The neighbouring lymphatic glands may now become enlarged and tender; feverish symptoms rapidly assuming a typhoid type set in, and the patient dies of sudden syncope, exhaustion or suffocation, or it may be of œdema of the glottis when the disease affects the neck. Should any doubt exist as to the nature of the disease, it will be cleared up by examining the contents of the vesicles for the bacillus.

The *bacillus anthracis* is a rod-like body, straight or sometimes bent, varying from $\frac{1}{2000}$ to $\frac{1}{1400}$ of an inch in length, and presenting cross-markings and sometimes round bodies (spores) in its interior. It multiplies by fission and by spores, and is itself readily killed by heat; but the spores resist both heat and drying, though they are destroyed by a 1 per cent. solution of perchloride of mercury and some other antiseptics. The bacillus has also been found in the blood and in various tissues of the body in this disease.

The *treatment* consists in the free excision of the pustule and cauterization of the wound with potassa fusa, chloride of zinc, carbolic acid, and the like. If this is done in time the patient usually recovers. When constitutional symptoms have developed the strength must be supported by fluid nourishments and by stimulants when indicated. Sulphide of soda in ten-grain doses has been recommended on account of the beneficial effect it exercises in splenic fever in animals.

General Infective Diseases.

SEPTICÆMIA OR SEPTIC INFECTION.—The term septicæmia is here restricted to the condition known as septic infection; septic intoxication, which has hitherto been included under the term septicæmia, has been already described under the head of sapræmia. Septicæmia, in this sense, is an infectious disease due to inoculation with a specific virus which multiplies in the blood, and is probably of the nature of a micro-organism.

Cause.—The essential cause is the introduction of the specific virus into the blood. The virus may be derived from the body of another patient who is suffering from or has died of the disease, and may be conveyed by the hand of the surgeon or the nurse, imperfectly cleaned instruments, sponges, &c. The minutest quantity of the poison appears to be sufficient.

Pathology.—The *post-mortem* appearances are similar to those of sapræmia. There is a like condition of congestion of the nerve-centres, gastro-intestinal tract and viscera, with petechiæ beneath the serous membranes, and staining of the vessels and tissues. Micro-organisms, however, are found in the blood. The serous cavities often contain blood-stained serum, and pleurisy and pneumonia may at times be present. The spleen is generally greatly congested and enlarged.

The *symptoms* are also similar to those of sapræmia; indeed, it is often impossible to differentiate between them. Septicæmia, however, may be suspected when there is evidence of infection from some source, or the wound is of such a size as to render it impossible for the amount of septic matter necessary to set up septic intoxication to be formed in it. It would, moreover, appear probable that the two diseases may at times coexist in the same subject. Septicæmia begins with a distinct rigor, which may be repeated, followed by a temperature of 103° to 104° or higher. The symptoms, the chief of which are headache, nausea, vomiting, delirium, and sometimes diarrhœa, may run the same rapid course as in sapræmia, the patient passing into a state of collapse; or they may be more chronic and less severe in degree though similar in kind, whilst leucocytosis and petechial eruptions of the skin, or bronchitis, pneumonia, pleurisy, or pericarditis may supervene.

Treatment.—Little can be done in the way of curative treatment beyond preventing the introduction of more poison by taking the same local means to disinfect the wound as were mentioned under sapræmia. The same good effects, however, must not be expected, as the poison once introduced multiplies indefinitely, and hence the disease is almost invariably fatal. Large doses of quinine or salicylic acid or sulphite of potash, however, may be given, whilst the strength should be supported by fluid nourishment and stimulants.

PYÆMIA is distinguished from septicæmia by the formation of secondary (*metastatic*) abscesses in various tissues and organs of the body. It received its name on the erroneous supposition that it was due to the entrance of pus into the blood, seeing that it generally originates in connection with a suppurating wound, and is later attended with purulent collections in various parts of the body. By some it is regarded as a later stage of septicæmia, as previous to the formation of the abscesses the two diseases are often clinically indistinguishable. Recent investigations, however, point to pyæmia being a disease distinct from either septicæmia or sapræmia, and have further made it appear probable that the train of symptoms known as pyæmia are due to several different pathological conditions depending upon distinct though similar poisons.

Cause.—The immediate cause is no doubt the entrance of a poison into the blood, though the nature of the poison is hardly known. In some cases micrococci have been found in the blood, the tissues, the metastatic abscesses and the wound. In other instances, however, though careful search has been made by competent observers, none have been discovered. It is probable, therefore, that there are at least two distinct pathological processes included under the term pyæmia; the one depending upon a poison of the nature of an infective micro-organism which multiplies in the blood, the disease being in this case distinctly infective in character; the other, in which no micro-organisms are found, depending merely on the entrance into the blood-stream of portions of a thrombus impregnated with septic products (*ptomaines*) derived from an unhealthy wound, this form of the disease being rather of the nature of sapræmia, complicated however by the formation of embolic abscesses, than a true infective process. Whatever the nature of the poison, it would generally appear to be developed in, or enter the system through, a wound which has reached the stage of suppuration and has not been properly drained and kept aseptic. Pyæmia is especially common after wounds involving bone, owing to the liability of the large patulous veins of bone to become filled with purulent thrombi, portions of which infected by the poison are readily carried away by the blood-stream. Hence the frequency of pyæmia after compound fractures, amputations, and excisions, when antiseptics and drainage are neglected. Again, the poison may be developed in decomposing portions of the placenta left after childbirth, and may then enter the blood by infecting the thrombi in the uterine veins. Or it may be formed in connection with operations on the genito-urinary tract, on account of the difficulty of keeping such wounds aseptic.

Pyæmia, moreover, is especially frequent after infective osteomyelitis and infective periostitis, even before the suppurating cavity is opened and exposed to the outer air. Here the poison probably depends upon a special form of micro-organism, as it would also appear to do when occurring in connection with erysipelatous wounds, diffuse cellulitis, and hospital gangrene, and when occurring, as it sometimes does, after gonorrhœa, ulceration of the intestines in typhoid fever and dysentery, and ulcerative endocarditis. Very occasionally pyæmia follows the most trivial operation or injury, as the subcutaneous division of a tendon or a portion of fascia. Here, again, it is probably the result of the introduction of infective micro-organisms at the time of the operation. At times no local source of infection can be discovered; the disease is then spoken of as idiopathic pyæmia, and it is believed that the poison, probably an infective micro-organism, gains admission, as in infective osteomyelitis, periostitis, and ulcerative endocarditis, through a mucous surface. Pyæmia, however, is seldom developed except where the patient is exposed to unfavourable hygienic conditions, amongst which may be especially mentioned overcrowding in ill-ventilated and badly-drained hospitals, particularly where a large number of suppurating and foul wounds are congregated together in the same ward: whilst the general debility induced by unsanitary dwellings, poor living, town life, and the abuse of alcohol in that it lowers the resisting power of the tissues, further predisposes to the disease.

Pathology.—The *post-mortem* appearances are similar to those in septicæmia, *plus* purulent collections in one or more situations, or disseminated throughout the body. Thus, there is the same rapid tendency to putrefaction, disintegration of red blood-corpuscles, staining of the vessels and tissues, minute extravasations (*petechiæ*) beneath the serous membranes, congestion of the viscera, enlargement of the spleen, and in many cases the presence of micrococci in the blood and various tissues and organs. The body is emaciated, and the skin yellowish and earthy in appearance.

The purulent collections may be found in the serous cavities, in the viscera, in the joints and indeed throughout the body generally. There may be one or more moderate-sized collections of pus: or an organ, as the lung, may be riddled by a number of small abscesses varying in size from a pea to a nut. The visceral abscesses are most common in the lungs, then in the liver, and next in the spleen, kidneys and brain. They are situated in the periphery of the organs, *i.e.*, in the situation of the smallest capillaries. Where, however, pyæmia follows a lesion of the rectum, the abscesses are generally found in the liver, since most of the blood from the rectum passes first through that organ. The pus is sweet, and may resemble laudable pus, or it may be thin and watery. In many cases it contains micrococci. When there is a wound it is usually found unhealthy or putrescent, and surrounded by an inflammatory area; micro-organisms are often present in it. The veins leading from the wound are usually filled with thrombi, which are generally, though not invariably, undergoing purulent softening, and frequently contain micrococci. Where the pyæmia has originated in infective osteomyelitis, infective periostitis, or in a wound involving bone, the veins in the medulla of the bone, and those leading from the bone are usually also found filled with purulent thrombi. If the affected veins are followed towards the heart, the end of the thrombus will often be seen projecting into the blood current in the larger vein at the spot where the smaller joins it. (Fig. 35.) Lastly, *coccus colonies*, *i.e.*, collections of micrococci, are often found in the various tissues and organs.

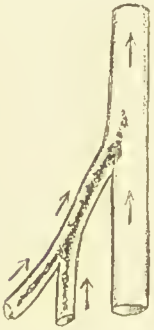


FIG. 35. — Thrombosed vein. The thrombus is seen projecting from the smaller into the larger vein.

A consideration of the above morbid appearances makes it appear probable that the metastatic abscesses may be produced in several ways:—1. Thrombosis of the veins leading from the wound is set up by one or more of the conditions that commonly produce thrombosis, such as suppuration around a vein, an abscess breaking into a vein, death of the part from which the vein runs, &c. The thrombus becomes impregnated with the septic products forming in the wound, or with infective micro-organisms introduced from without. The septic or infective changes extend up the thrombus; portions of the thrombus where it projects into a larger vein are detached by the force of the blood-stream in the larger vein, see Fig. 35, and are carried away in the blood, and become lodged in the capillaries of the lungs or, possibly, escaping through them, in the capillaries of other parts of the body. These emboli, being of a septic or infective nature, instead of leading to the changes which follow ordinary embolism, give rise to septic or infective inflammation, terminating in suppuration and abscess (*primary embolic abscess*). 2. Masses of micrococci which have gained entrance, either directly through a wound, or indirectly through a mucous membrane, as in the case of infective periostitis, osteomyelitis, &c., are carried from the primary seat of disease by the blood-stream, and become lodged in the capillaries of the various tissues and organs. There blood-corpuscles aggregate around them, thus forming a thrombus, which softens and sets up infective inflammation and suppuration around. 3. Portions of the softened thrombus in the lung capillaries become detached, and are carried by the blood-stream to other parts of the body, where they in turn form emboli, which also set up similar infective inflammation and suppuration (*secondary embolic abscesses*). 4. The diffuse purulent collections in the serous and synovial cavities are thought to depend upon the poisoned condition of the blood and not upon emboli.

The *symptoms* usually set in with a rigor, generally a severe one, during which the temperature rises to 103°, 104°, or even higher. Profuse sweating follows. The rigors are repeated from time to time. The temperature chart presents the same series of long up and down strokes characteristic of hectic fever, only differing in that the morning temperature in pyæmia seldom reaches normal. The pulse is quick; the tongue is red or glazed, and later, dry and brown; wasting rapidly sets in; the skin often assumes an earthy or jaundiced hue; the face is anxious, perhaps flushed or pale; extravasations from the capillaries of the skin occur producing petechiæ; and other eruptions, though less common, as patches of erythema, may appear from time to time, with aphthæ or ulceration of the fauces. The breath and the exhalations of the body have a peculiar sweet odour, and albumen may be found in the urine. At about the end of a week metastatic abscesses form in various parts, as the lungs, liver and joints; or diffuse suppuration may be set up in the serous cavities, and signs of pericarditis, pleurisy, or peritonitis ensue. Diarrhœa sets in, then delirium, and the patient dies exhausted usually during the second week. In the meanwhile, the wound, if one exists, is generally foul and suppurating: though later, it may become dry and cease to form pus; in some chronic cases, however, the wound may heal. The *prognosis* is extremely unfavourable; acute cases are always fatal, each rigor making the chance of recovery more hopeless. At times, however, the disease may run a chronic course (*chronic pyæmia*), differing from the acute in degree rather than in kind. The rigors are less frequent, or none may occur. The viscera, as a rule, are not affected, and the abscesses show a special predilection for the joints. The patient may die after some weeks, or may linger for some months, or very slowly recover after one or more relapses, with probably stiffness of one or more joints. Or he may subsequently die of phthisis, albuminuria, or lardaceous disease.

Treatment.—Little or nothing can be done in the way of treatment in acute cases, when once the pyæmic process is established, beyond supporting the strength by fluid nourishments and stimulants, opening abscesses as they are formed, and placing the patient under the most favourable hygienic conditions possible. Measures should, of course, be taken to drain the wound and render it aseptic if this has been neglected. Quinine in large doses is generally advised, but little must be expected from it. In infective osteomyelitis and periostitis amputation through the joint above the affected bone should be done if pyæmia appears imminent but has not fully declared itself. In chronic cases, when convalescence has ensued, a sea voyage or residence at Aix-la-Chapelle or other suitable spa may be of benefit.

GLANDERS is an infective disease common amongst horses, and occasionally communicated to man by inoculation through a wound or the unbroken mucous membrane. The poison is believed to be a specific form of micro-organisms, since in glanders a bacillus has been found, which after several cultivations retains the power of reproducing the disease in the horse. The disease may run an acute or chronic course. *The acute form* is characterized: (1) by a thin serous discharge, rapidly becoming foul, purulent, and sanious, from the nasal mucous membrane, with enlargement of the submaxillary glands; (2) by a pustular eruption, resembling that of small-pox, on the skin and mucous membrane of the respiratory and digestive tract; and (3) by the formation of circumscribed nodules in the subcutaneous and muscular tissue, which usually soon break down into abscesses and foul ulcers. These signs are ushered in and accompanied by fever, which rapidly assumes a typhoid type, and is sometimes preceded by a rigor. Symptoms of pneumonia or pleurisy, or vomiting and diarrhœa ensue, according as the respiratory or alimentary tract is chiefly affected, and death usually takes place within a week from sapræmia, septicæmia, or pyæmia. In the *chronic* form the constitutional symptoms are less severe, and the patient may linger for months, or even recover.

In the horse the disease is spoken of by veterinary surgeons as "*farcy*" when the lymphatic vessels and glands are principally affected, the swellings opposite the valves in the lymphatics forming the so-called "*farcy-buds*;" and as *glanders*, when the disease falls chiefly upon the nasal mucous membrane. In man the two processes generally occur together as above described.

Treatment.—Beyond supporting the patient's strength with concentrated fluid nourishment, opening abscesses as they occur, dressing the ulcers antiseptically, and syringing out the nasal chambers with antiseptic lotions, little or nothing can be done, as no treatment appears to have been hitherto of any avail.

HYDROPHOBIA is a disease depending upon a specific poison introduced into the system through the medium of the saliva of a rabid animal. In the human subject it is generally the result of the bite of a dog, occasionally of a cat, and more rarely of a wolf or a fox. At times inoculation has occurred through a scratch which has been only licked by the affected animal, and once through making a *post-mortem* examination on a subject who had died of the disease. All persons bitten do not have hydrophobia, a fact which may possibly in part depend upon the saliva being wiped off the tooth in its passage through the clothes. Thus, while one half of those bitten are said to be affected, nine-tenths of those attacked in the face fall victims, but only one-fifth of those who are bitten through the clothes. The excessive danger of bites on the face appears, moreover, to be due in part to the greater vascularity of the tissues of this region, and consequently the more rapid absorption of the poison, and in part to the inability of the patient to apply suction. The *average period of incubation* varies from six weeks to three months. Although it is said that the incubation period has been as short as two days, and as long as twenty years, two weeks to two years may practically be given as its limits. There are no symptoms during this period. The vesicles or lyssæ said to occur under the tongue from the third to the ninth day after the bite do not appear to be a constant phenomenon.

Pathology.—The principal *post-mortem* changes have been found in the medulla, especially about the region of the glosso-pharyngeal, pneumo-gastric and hypo-glossal nuclei, and in the cerebral cortex. They consist in the infiltration of the perivascular sheaths with leucocytes, thrombosis of the medium-sized vessels with small hæmorrhages, and degeneration of the nerve cells. The theory now generally held with regard to the pathology of the disease is that the poison after remaining for a variable time dormant in the wound, multiplies or matures; and then that either it or its products slowly enter the blood and set up a specific inflammation in the medulla and cerebral cortex, whereby their power of resistance to reflex irritation is diminished or lost. Hence the occurrence of the spasm on the slightest provocation. Finally, that should the patient not succumb to spasm of the glottis or muscles of respiration, the affected nerve-centres become exhausted and no longer respond at all to the reflexes necessary to carry on life, and the heart's action in consequence ceases. The nature of the poison is not known, though the belief is gaining ground that the disease depends in some way upon a micro-organism, since rod-like bodies have been discovered in connection with the hæmorrhagic lesion in the cerebral cortex, and a micro-organism has been isolated by inoculating fowls with the virus taken from rabid animals.

Symptoms.—Tingling or itching, and sometimes inflammation or vesication about the site of the wound, which has generally long since cicatrized, enlargement of the neighbouring lymphatic glands, and nervous irritability, are described as premonitory symptoms, but do not appear to occur in all cases. The disease is usually, though not invariably, ushered in by a feeling of mental depression and melancholia, anxiety and often gastric disturbance. Sometimes a slight difficulty in swallowing and a peculiar click in respiration due to spasm of the diaphragm is noticed. After two or three to four or five days the disease becomes fully developed, and the patient is unable to swallow in consequence of the muscles of deglutition being thrown into spasm when he attempts to do so. The spasms of the respiratory muscles become more pronounced, the diaphragmatic spasm causing the patient to emit a peculiar sound. Hence the popular saying that he barks like a dog. The spasm of the muscles of deglutition are at first only excited by attempts to swallow, but subsequently the sight of water, or the sound of its trickling from one vessel to another, or even a blast of cold air or a sudden light is sufficient to set it up. In addition to the spasms, the patient suffers from hallucinations, and viscid saliva escapes from his mouth. The acute stage generally lasts from one to four days, sometimes as long as ten days; death being due to exhaustion, spasm of the glottis, or spasm of the respiratory muscles. Sometimes a delusive calm, during which the convulsions cease, occurs for half an hour to an hour or so before death, which then takes place from asthenia.

Diagnosis.—The *intermittent* character of the spasms (*clonic spasms*), the hallucinations, and the escape of viscid saliva from the mouth, will generally serve to distinguish hydrophobia from tetanus following the bite of a dog, and from false or hysterical hydrophobia. In the latter case, too, the convulsions will cease when the patient is put under chloroform.

Treatment.—If the patient is seen immediately after the bite, we should endeavour to remove the poison from the wound, or else destroy it. This may be attempted by suction, a procedure which appears to be quite safe provided there is no crack or abrasion about the lips or tongue; or if at hand, a cupping glass may be applied. The parts should afterwards be excised or thoroughly cauterized, the best caustics being nitric acid, nitrate of silver, caustic potash, and pure carbolic acid. If the wound has already healed when the patient is seen the cicatrix should be cut out. The inoculation with attenuated virus as practised in Paris by M. Pasteur should not be neglected, although we are hardly in a position at present to judge of its value as a prophylactic. When the disease is once established nothing has hitherto proved of any avail. Chloral, opium, or chloroform may be given to alleviate the spasms; and subcutaneous injections of pilocarpin and curare, which are said to have been successful in one of two cases, may be tried. The patient should be isolated and placed in a darkened room, and every source of irritation avoided.

TETANUS is a disease in which the voluntary muscles are thrown from time to time into a state of intense spasm, whilst they remain in the intervals in a condition of constant contraction (*tonic spasm*).

Cause.—Tetanus is generally attributed to a lesion of the peripheral nerves; but recent researches render it highly probable that it is an infective disease depending upon a specific virus generated by the growth of a micro-organism. It is especially prevalent in hot climates, and amongst the negro-races, and occurs more often in men than in women, and in military than in civil practice. It is seldom met with in this country except in connection with a wound, and is especially common after lacerated and punctured wounds and burns; but it has been known to occur after every kind of wound, from a mere scratch, or the ligature of a pile or the umbilical cord, to amputation of the thigh or other capital operation. Tetanus, however, has been more often observed to occur when the wound, whatever its cause and character, is in a septic condition. Exposure to cold, damp, and sudden changes of temperature are believed to influence its production, and where tetanus occurs, as it sometimes does, independently of a wound, are regarded by some as the essential cause. It is more probable, however, that these conditions merely act as depressing agents, and that the micro-organism in these cases gains admission through a scratch or abrasion which has been overlooked, or by absorption through the unbroken mucous or cutaneous surface.

Tetanus appears to be inoculable from animal to animal, and from animals to man, since a veterinary surgeon has lately died of tetanus after making a post-mortem examination on a horse dead of the disease.

Pathology.—But little is discoverable on *post-mortem* examination. At times the nerves leading from the wound have been found congested, at other times unaltered in appearance. Hyperæmia of the medulla and cord, exudation in, and degeneration of the grey matter, and hæmorrhages in the white columns, have been noted in some cases; whilst in others nothing abnormal in the nerve-centres has been discovered. Two distinct views are held as to the pathology of the disease, and may thus be briefly stated:—1. That the disease depends upon a primary lesion of the peripheral nerves, and that the irritation thus produced is conveyed by the injured nerve to the nerve centres, where it becomes persistent and continuing after the real cause has been removed, gives rise to muscular spasm in various parts of the body. 2. That the disease is due to a specific virus which affects the medulla and cord in a way similar to strychnine. The virus is believed to be a chemical compound of the nature of a ptomaine (tetanin, tetano-toxin, &c.), and to be usually generated in a wound by the growth of a specific micro-organism. When no wound exists, it is further believed that the virus may gain admission by absorption through the unbroken mucous or cutaneous surface. The micro-organism is supposed to be a bacillus, but an absolutely pure culture has not yet been obtained. This bacillus has been found in many kinds of ordinary earth, thus serving to explain the frequency of tetanus in the wounded who have been allowed to lie on the ground after battles. It has also been found in soil taken from beneath the floor of wards in which several cases of tetanus have occurred. From recent researches it would appear that the bacillus only exists in the wound; not in the blood or nervous system.

The *symptoms* usually begin by a feeling of stiffness in the muscles of the neck; the patient complains that he is unable to open his mouth widely (*trismus*), and that his throat feels sore on swallowing. On examination, the muscles of the neck, the masseters, and perhaps the abdominal muscles, are found hard and rigid, and the face presents a characteristic expression from the angles of the mouth being drawn slightly upwards by the contraction of the facial muscles. Later, other of the voluntary muscles, especially those of respiration, become affected, and distinct spasms attended with severe pain and varying in duration, occur from time to time. The spasms are induced by the slightest irritation, a breath of air, the least noise, the merest touch, and the remissions become shorter, or only partial, as the disease is fully established. During the spasms the face assumes an expression of intense anguish (*risus sardonicus*), the respirations and pulse are quickened, and the body is variously contorted. Thus, when the spinal muscles are chiefly affected the back becomes arched, so that in severe cases the patient rests only on his head and heels (*opisthotonos*); more rarely the body is bent forward, being rolled up as it were like a ball (*emprosthotonos*); whilst still more rarely it may be drawn to one or other side (*pleurosthotonos*). The skin is bathed in perspiration, the urine concentrated and high coloured, and the bowels are obstinately confined. The temperature may remain normal, or be but slightly raised; though sometimes shortly before death it runs very high, and has been known to register 112° Fahr. The patient is unable to sleep, but the intellect continues clear to the end. Death may occur from spasm of the glottis, spasm of the respiratory muscles, or from exhaustion or syncope. Recovery hardly ever takes place when the symptoms are acute, but if the patient survive till the twelfth day the prognosis is more favourable, and becomes more and more so every day.

Diagnosis. — From strychnia poisoning and hydrophobia, tetanus is distinguished by the spasms being of a tonic instead of a clonic character, and further from hydrophobia by the absence of hallucinations and the discharge of viscid saliva, signs which are characteristic of that affection.

Treatment.—Nothing in the way of specifics has hitherto been found for the disease. Curare, Indian hemp, Calabar bean, eserine, and numerous other drugs have been tried, and signally failed, at least in the acute form of the disease. Chloroform, although it prevents the spasms while the patient is under its influence, appears to be of no permanent benefit. All that can be done is to attempt to tide the patient through the first few days in the hope that the affection may become chronic. Thus his strength must be supported with fluid nourishment, administered by the rectum if he is unable to swallow, and the spasms as much as possible prevented by the most absolute quiet, the avoidance of all sources of irritation, and the employment of such sedatives as Indian hemp, bromide of potassium, chloral or opium. If the latter is chosen, it should be pushed to the extreme verge of safety. In the few cases I have seen recover, the patient was treated by excessive doses of this drug. The bowels should be cleared by purgatives or enemata. Locally, under any circumstances, means should be taken to render the wound aseptic, and in the light of recent researches that seem to show that tetanus is due to a poison generated by micro-organisms which exist only in the wound, the practice of free incision of the injured part and subsequent thorough cauterization on the first appearance of the symptoms, commends itself for adoption.

SECTION III.

INJURIES OF SPECIAL TISSUES.

INJURIES OF BONES.

FRACTURES.—A fracture may be defined as a sudden and forcible solution of continuity of a bone.

The *causes* of fracture are predisposing and exciting. 1. The *predisposing causes* may be enumerated as senile atrophy, fatty degeneration, rickets, mollities ossium, locomotor ataxy, strumous, tuberculous and syphilitic inflammation, caries and necrosis, and malignant growths; in brief, any condition rendering the bone unusually fragile, to which may be added the male sex as more frequently exposing to violence. The exciting causes are either *external violence* or *muscular action*. 1. *External violence* may be direct or indirect. In fracture from *direct violence* the bone is broken at the spot where the violence is applied. Such fractures are usually attended with more serious consequences than fractures from indirect violence, since the soft parts are, as a rule, much injured, and the fragments comminuted or fissured, and, perhaps, driven into important organs, as the lung in fracture of the ribs, or the brain in fracture of the cranium, &c. In *indirect* violence the fracture occurs at a distance from the spot where the violence is applied, as, for instance, a fracture of the clavicle from a fall on the arm. The bone usually breaks at its weakest spot, and the fracture may be rendered compound from the fragments, which are very sharp and irregular, being driven through the soft parts. Fracture from indirect violence is most common in the bones of the extremities, and the base of the skull. 2. *Muscular action*, except in the case of the patella, is not a common cause of fracture. When the long bones are broken in this way, they are usually the seat of some of the diseases mentioned above as predisposing causes. When a bone infiltrated with a malignant growth, or softened by mollities ossium, breaks from very slight violence, the fracture is said to occur *spontaneously*.

Varieties of fracture.—A fracture is said to be *simple* when the skin covering it is not broken; *compound* when a wound through the skin and soft parts leads down to the seat of the fracture. Whether simple or compound, fractures are further spoken of:—1. According to their extent, as:—*complete*, when the bone is broken quite across; *incomplete*, or *greenstick*, when partially broken and partially bent; *comminuted*, when broken into several pieces; and *multiple*, when two or more distinct fractures occur in the same bone, or in different bones. 2. According to the condition of the fragments, as:—*impacted*, when one fragment is driven into another: *fissured*, when there is a mere crack through the bone without displacement; *depressed*, when one fragment is pressed in below the surface, as in some fractures of the cranium; *punctured*, when there is a small perforation with driving inwards of the fragments: and *splintered*, when only a fragment of bone is chipped off. 3. According to the line of fracture, as:—*transverse*, *oblique*, *spiral*, *longitudinal*, or *stellate*, terms which sufficiently explain themselves. A fracture, moreover, is said to be *complicated*, when associated with other injuries, as rupture of the main artery of the limb, implication of a large joint, &c.

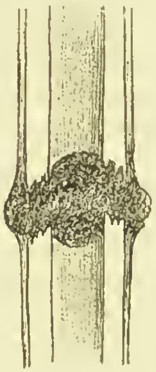
Displacement of the fragments, especially in the bones of the limbs, commonly occurs, except the fracture is transverse, when, as in the case of the tibia, there may be little or none. The causes of the displacement may be enumerated as: 1. The weight of the limb acting on the lower fragment; 2. Muscular contraction; and 3. The violence producing the fracture. The amount of displacement will depend in part on the direction of the line of fracture, and in part on whether the periosteum is or is not torn. Thus the displacement is usually considerable when the fracture is oblique, insignificant when transverse, especially if the periosteum is intact. The displacement is spoken of as *angular*, *lateral*, *longitudinal*, and *rotatory*, according to the direction which the fragments bear to each other.

Signs.—Before examining for fracture, the clothes should be carefully removed, and the parts handled tenderly, lest a simple fracture be converted into a compound by a sharp fragment being driven through the skin. Thus, in the case of the leg, the boot should be cut off, the trousers ripped up the seam, and the stocking split with scissors. The injured side should always be compared with the sound side. The general signs of fracture are:—1. Alteration in the shape of the part; 2. Swelling; 3. Loss of function; 4. Preternatural mobility; 5. Shortening; 6. Pain; 7. Crepitus; 8. The sensation of a sudden snap or giving way of the bone experienced by the patient. No one of the above signs alone, except *crepitus*, is absolutely diagnostic of fracture; and crepitus itself, when the fragments are impacted, may be absent, or may be simulated by joint-crepitus, effusion into the sheaths of tendons, emphysema, and by the grating of osteophytes in chronic osteo-arthritis. True crepitus, however, having been once felt, can hardly afterwards be mistaken; it is readily distinguished from false crepitus by its harsher and more grating character. The *shortening* may be natural or due to some previous injury or disease, as a former fracture, osteo-arthritis, &c.; it also occurs in dislocation. *Increased mobility* may not be present, as when a fracture is firmly impacted. *Pain* may, of course, occur from causes other than fracture; it may often be elicited in fracture when crepitus cannot be obtained. *Swelling, loss of function, and alteration in the shape* of the part may be present in other injuries, but are useful signs in some forms of fracture. Too much weight, it need hardly be said, should not be given to the patient's *sensations;* as a snap or feeling of the bone giving way may occur in rupture of a tendon, ligament, &c.

The *Diagnosis* is often difficult, especially:—1. When the fracture is near, or extends into, a joint, owing to effusion of blood or synovial fluid into the joint-cavity. 2. When there is great extravasation of blood, or later, effusion of inflammatory products about the fragments. 3. When the fracture is transverse, and there is no displacement, especially if the fragments are held in position by a companion bone, as the fibula in fracture of the tibia. 4. When the fracture is subperiosteal. In the cranium, a simple uncomplicated fissured fracture cannot be diagnosed.

How to obtain crepitus.—Grasp the limb firmly above and below the suspected fracture, and when there is shortening, make extension to bring the rough surfaces into contact. Then gently attempt to move the lower on the upper fragment. Having once assured yourself that crepitus is present, desist from your manipulations, as they not only give the patient pain, but injure the soft parts. In some cases, as in fracture of the neck of the femur, where the nature of the injury from the presence of other signs is quite obvious, crepitus should not be sought, lest an impacted fracture be rendered non-impacted and afterwards remain ununited, or the periosteum uniting the fragments be torn, and a like result ensue.

The Method of Union is similar to that which occurs in the healing of a wound of the soft parts by the first intention. Blood is at first extravasated between and around the fragments (Fig. 36). Then quickly follows a simple traumatic inflammation; the periosteum, and adjacent soft tissues, together with the medulla, become infiltrated with leucocytes, which have escaped from the vessels of the inflamed periosteum, medulla, and bone. The inflammation subsides in a few days, leaving the fragments embedded in a mass of soft, red, gelatinous material (*granulation tissue*), derived chiefly from the leucocytes, but according to some observers in part from the remains of the extravasated blood that has not been



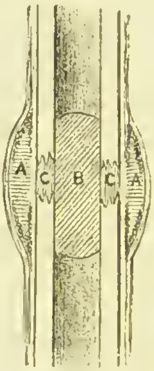


Fig. 36.—Diagram of the fragments a few hours after simple fracture. The periosteum is torn and ragged, and separated for a slight distance above and below the fracture from the bone. Blood is extravasated between the fragments, in the medullary canal, and in the periosteum and other soft tissues surrounding the fracture.

Fig. 37.—Diagram of the process of repair in simple fracture. A. Ensheathing callus; B. Internal callus; C. Permanent callus. Commencing ossification of the ensheathing callus is indicated by the darker shading at the angle between the periosteum and the bone.

absorbed. This granulation tissue, which is called *callus*, consists here, as in the union of soft parts, of small round cells with a small amount of firm intercellular substance, and delicate loops of capillaries, which are derived in part from the vessels in the Haversian canals, and in part from the vessels in the periosteum and adjacent soft tissues. It is found (1) replacing the periosteum, and extending for some distance around the bone, above and below the line of fracture, forming a spindle-shaped tumour, by which the ends of the fragments are surrounded, as it were, with a ferrule (*ensheathing callus*, Fig. 37, A); (2) replacing the medulla for some little distance up and down the medullary canal (*internal callus*, Fig. 37, B); and later (3) between the ends of the fragments (*permanent, intermediate or definitive callus*, Fig. 37, C). The ensheathing callus and internal callus are gradually organized into fibrous tissue, becoming harder and firmer, and in animals and, in some instances, in children, are converted into cartilage, or fibro-cartilage. The outermost layers of the fibrous tissue into which the ensheathing callus is thus converted, form a new periosteum. Ossification of the ensheathing callus now begins—generally in the angle between the periosteum and the bone, and proceeds along the surface of the bone, where it is preceded by the formation of cells like osteoblasts, and also along the surface of the ensheathing callus beneath the new periosteum, till the two layers of ossifying callus meet opposite the line of fracture. Ossification of the internal callus goes on at the same time. Permanent callus, as soon as the ends of the bone are thus fixed by the ensheathing and internal callus, is formed between the ends of the fragments, and later also undergoes ossification. It is probably derived from leucocytes which have escaped from the vessels in the enlarged Haversian canals of the inflamed and softened ends of the fragments. The ensheathing callus and internal callus having discharged their functions, are now gradually absorbed.

Where the ends of the fragments overlap, the ensheathing callus fills up the angles; and while the open end of the medullary canal in each fragment is thus closed, its continuity through the bone is restored by the absorption of the intervening walls of the contiguous and overlapping fragments (Fig. 38). When the fragments are in good apposition, and are kept at rest, little or no ensheathing callus is formed; but when there is much displacement, or rest is impossible as in fractured ribs, or difficult to obtain as in a fractured clavicle, a considerable amount is produced. In children, even when the parts are kept at rest and in good apposition, the formation of much ensheathing callus is the rule.

Treatment.—Here only the indications for treatment will be pointed out. The particular methods will be given under Special Fractures.

A. *Treatment of simple fracture.*—The indications are—(1) to reduce the fracture, that is, to place the fragments in apposition, so as to restore as far as possible the bone to its normal shape; (2) to keep it in this position by properly applied apparatus till firm union has occurred; (3) to promote the restoration of the normal functions of the part; and (4) to attend to the general health and comfort of the patient.

1. The *reduction*, or as it is popularly called, the setting of the fracture, should not be undertaken till the apparatus into which the limb is to be permanently placed is ready; but the fragments should be temporarily fixed so as to prevent further injury, such as a sharp fragment being forced through the skin. Thus, in the case of the lower extremity, the injured limb may be bound to the sound one, or secured to an impromptu splint such as an umbrella or walking-stick, by a handkerchief; or if the patient is not seen till he is already in bed, the limb may be placed between sand-bags. As a general rule, the fracture should be reduced as soon as possible; but where there is much swelling, the part may be wrapped in a pillow or secured by sand-bags till the swelling has subsided. When the fracture is transverse, the fragments will, as a rule, be but slightly displaced, and little as regards reduction will be required. In other instances, as when the line of fracture is oblique, considerable trouble in bringing the fragments into apposition may be experienced. The chief obstacles to be overcome are (1) the contraction of the muscles, which are thrown into action by the irritation of the fragments; and (2) the impaction of the fragments, or the interposition of muscle or tendon between them. The splint or other apparatus being in readiness, extension in the case of fracture of a limb should be made on the lower fragment, preferably, as a rule, through the intervention of the joint below. Thus, in fracture of the fore-arm or leg, exten-

sion should be made from the hand or foot respectively, whilst counter-extension is applied at the same time to the upper fragment, also preferably through the joint above. Whilst steady traction is thus being made, the surgeon should gently manipulate the fragments, and he should not rest satisfied till the symmetry of the part has been as far as possible restored, and the limb is found, both on inspection and measurement, to correspond as near as may be with the opposite side. In this position the parts should be held till the apparatus for permanently fixing them has been applied. Where great difficulty is experienced in reducing the fracture owing to muscular spasm, the limb should be flexed or placed in such a position as will tend to relax the opposing muscles, or if this does not suffice an anæsthetic may be administered. At times the subcutaneous division of a tendon may become necessary before the fracture can be reduced. In impacted fractures, as of the neck of the humerus or femur, it may be advisable not to disturb the fragments, as by so doing non-union, a worse condition than impaction, may result. The special methods of reduction which may be required for certain fractures will be given under Varieties of Fracture.

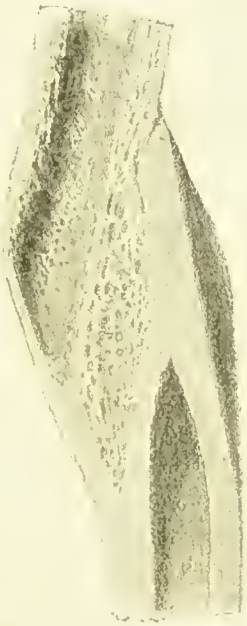


FIG. 38.—Fracture of the femur with overlapping fragments to show rounding off of angles, and restoration of medullary canal by absorption of intervening bone. (St. Bartholomew Hospital Museum.)

2. *To keep the fragments in apposition* till union has taken place, numerous contrivances have been invented. They may be said to consist of splints, cradles, fracture-boxes, bandages hardened by plaster-of-Paris, silica, paraffin, glue, or gum and chalk, and such material as gutta-percha, poroplastic felt, and leather, moulded to the individual case. The *method of applying splints* will be better learnt by three months' dressing in the wards

than by any verbal description. The points that should be chiefly attended to are:—1. The splints should be well padded. 2. Pressure should not be made over points of bone. 3. Strapping or bandages should not be put on too tightly. 4. Circular constriction of the limb should be avoided. 5. The splints where possible should reach beyond both the joint above and the joint below the fracture. 6. The fracture should not, as a rule, be covered with the bandage. 7. The patient should be seen within twenty-four hours after the splints have been applied, as swelling of the part is apt to occur, and the bandages thus become too tight. 8. The part having once been properly secured in splints, should not needlessly be disturbed. 9. Should the fragments become displaced from spasm of the muscles, steady extension as by a stirrup, weight, and pulley will usually overcome the difficulty. 10. The part below the fracture may sometimes be bandaged with advantage to prevent œdema.

The time the splints should be kept on varies greatly, and will be stated under each individual fracture. On their removal the limb should be kept at rest for some time longer in a plaster-of-Paris, gum and chalk, or other form of stiff bandage till complete consolidation has taken place. At some hospitals the fracture, if not severe, is placed at once in a plaster-of-Paris bandage or plaster-of-Paris splints (*Bavarian splints*). If this or other similar material is used, the limb should be well padded with cotton wool, the toes or fingers left exposed, the joints above and below included in the bandage, and the limb subsequently raised. The patient should be visited a few hours after the plaster-of-Paris has been applied, so that should the circulation have become impeded from swelling of the limb, the plaster bandage may be removed before any serious damage has had time to ensue. The indications for at once removing, or for loosening the bandage by cutting it in places are: 1, much pain; 2, swelling; 3, numbness; and 4, signs of obstructed circulation in the fingers or toes. A tight bandage, it should be remembered, is more dangerous in the upper than in the lower limb, because in the former most of the venous return is by the superficial veins. Should the bandage become loose, it must of course be removed and re-applied.

3. *To promote the restoration of the normal functions of*

the part physiological after-treatment is required. Thus it will often be found after the apparatus is finally removed, especially if the fracture is near a joint, that the joint is stiff, the tendons are more or less glued together, and the muscles wasted and atrophied. Under these circumstances shampooing, massage, electricity, friction with stimulating liniments, and passive movements of the joint, should be sedulously employed.

4. *The general health and comfort of the patient* should not be neglected. Thus if he is confined to bed, boards should be substituted for the ordinary webbing or steel laths of the bedstead; the sheets should be kept smooth; and bed-sores guarded against by the use of water-cushions and by hardening the skin over prominent parts of bone with spirit lotions. Old people should not be kept too long in bed, lest passive congestions of the lungs occur. The general health should be promoted by attention to the secretions, regulation of the diet, and administration of sedatives to relieve pain and promote sleep.

UNUNITED FRACTURE AND FALSE JOINT.—*An ununited* fracture is one in which the fragments are either totally ununited, or merely bound together by fibrous tissue. Some fractures, such as transverse fractures of the patella, and fractures extending into joints in general, seldom or never unite by bone, but remain merely bound together by fibrous tissue; but as fibrous union here appears to be the normal method of repair they are not, as a rule, spoken of as ununited fractures. The condition of the fragments varies. They may be completely separated, with the ends rounded off and the medullary canal closed; or they may be bound together by long pliable bands of fibrous tissue permitting of considerable movement, or by tough fibrous bands allowing of but very little, or by a fibro-cartilaginous material—a kind of ensheathing callus. The last condition, however, is thought by some to be merely an example of *delayed union* and not one of permanent ununited fracture.

A false joint or *pseudarthrosis* is merely a variety of ununited fracture in which the ends of the fragments are rounded off and eburnated, or covered with a layer of fibrous tissue or fibro-cartilage, and enclosed in a strong fibrous capsule formed by the condensation of the surrounding soft tissues. A fluid resembling synovia has occasionally been found within the capsule. A false joint may resemble a hinge or a ball-and-socket joint. The latter condition is more common in fractures near the articular ends of bone where rotatory as well as angular movement may occur; the former in the shaft where angular movement only is permitted.

The *Causes* are local and constitutional. The *local* are —1, The fragments not having been kept thoroughly at rest; 2, The fragments not having been placed in apposition in consequence of (*a*) muscular contraction; (*b*) the loss of a large piece of bone, as in compound fracture; (*c*) the intervention of a piece of muscle, tendon, or periosteum between the fragments; and (*d*) the effusion of synovial fluid in the case of a fracture into a joint; 3, The necrosis of the end of one of the fragments; 4, The interference with the arterial supply of one of the fragments, as from injury of the medullary artery; and 5, The poor supply of blood to one of the fragments, as in fracture of the anatomical neck of the humerus.

Constitutional causes.—Syphilis, struma, gout, Bright's disease, fever, scurvy, the cancerous cachexia, pregnancy, old age, alteration of the patient's habits, and sudden deprivation of stimulants, are all said to be causes of ununited fracture. No doubt any condition that lowers the vitality and consequent power of repair of the tissues has a tendency to delay union, but it seems doubtful if any of the above conditions except scurvy is in itself, apart from the local causes, sufficient to prevent the bone uniting.

Sometimes the callus, after having been formed, appears to be re-absorbed, the fracture being then spoken of as *disunited*. This appears to be not uncommon in scurvy.

Treatment.—Constitutional as well as local treatment may be required. In recent cases—*i.e.*, where the fracture is found ununited after having been kept in splints for the usual time, a condition sometimes called *delayed union* in contradistinction to ununited fracture, the splints should be re-applied, and in such a manner as to ensure perfect immobility of the fragments; whilst the general health should be improved by every means in our power; and any constitutional taint as syphilis, gout, &c., that may be detected, combated by appropriate remedies. If the patient has been accustomed to stimulants, and has been deprived of them, he should be allowed a moderate quantity. In some cases it may be expedient to put the fracture in an immovable apparatus, and let the patient get about on crutches. Should union still not occur, the ends of the fragments should be rubbed together to excite some amount of inflammation, and splints or other apparatus be again applied. This failing, and in long-standing cases, two courses are open; either to try to unite the fragments by some operative procedure, or to apply some form of permanent apparatus to fix them in position. The choice of these methods will depend upon the situation of the fracture, whether it is of the nature of an ununited fracture or a false joint; and upon the patient's age, constitutional condition, occupation, and rank of life. Thus, in the case of an ununited fracture of the upper third of the femur in a patient of advanced age or of broken constitution, an operation is attended with the greatest risk to life, and for such, some form of apparatus is better suited. But when the patient is young or of good constitution, or his occupation is such that he cannot afford an apparatus and the continual expense of keeping it in good order, and especially where the fracture is in the shaft of the humerus, an operation may be undertaken. Such operations may be divided into two classes—1, those having for their object the setting up of inflammation about the ends of the fragments, or in the fibrous tissue uniting them, and so inducing ossification; and 2, the cutting out of the false joint, and bringing the refreshed surfaces of the bone into apposition, and keeping them there till union has occurred. Among the former, which are applicable to an ununited fracture rather than to a false joint, may be mentioned —1, the subcutaneous scraping of the ends of the fragments; 2, passing a seton between them; and 3, cutting down upon and inserting ivory pegs into the fragments. Of these the subcutaneous method appears attended with the least risk, and is the one that should as a rule be first undertaken. The passage of a seton is highly dangerous. The operation for cutting out a false joint consists in making an incision down to the bone, and then chiselling or sawing away obliquely the ends of the fragments and wiring them together, or fixing them by ivory or metal pegs. This operation, though attended with less risk than formerly, is still a grave one, and should only be undertaken after the case has been fairly weighed in all its aspects. Quite recently an attempt has been made in an ununited fracture of the tibia with loss of substance from necrosis, to fill the gap by grafting a piece of bone between the fragments, and apparently with some success.

MALUNITED FRACTURE OR VICIOUS UNION.—1. Fractures in consequence of having been improperly set or not kept at rest in a good position, may unite at an angle, or in some other faulty direction. 2. If splints have been removed too early, or in the case of the lower extremity the patient has been allowed to walk too soon, the callus may yield, and deformity result. 3. Two adjacent bones, as the radius and ulna in the fore-arm, may become united to each other by callus. 4. A green-stick fracture from neglect to straighten the partially bent bone before applying splints may consolidate in its distorted condition.

Treatment.—If the fracture is recent, and the fragments are not firmly united, the patient should be placed under chloroform, and the faulty position rectified and splints properly applied. If firm union has already occurred, an attempt should be made to refracture the bone under chloroform; and if this fails, and in long-standing cases, subcutaneous osteotomy may in some instances be performed, or a wedge-shaped piece of bone removed. Where a sharp fragment projects beneath the skin, it may sometimes be advantageously sawn off, though it should be remembered that it will often become rounded off with time.

SEPARATION OF EPIPHYSES.—This injury may be regarded as a variety of fracture. It consists in the forcible wrenching of the epiphysis from the shaft at their cartilaginous line of union, and consequently can only occur in subjects under twenty-one years of age, the period at which nearly all of the epiphyses have united with the diaphyses. The injury is most common in the upper and lower ends of the humerus, and, from the proximity of the epiphysial line to the shoulder and elbow-joints, is liablo to be mistaken for a dislocation. Repair usually takes place by osseous tissuo; hence the bone ceases to grow at the injured end, and permanent shortening of the limb if the patient has not completed his growth will then result. For treatment, see *Special fractures* and *dislocations.*

A COMPOUND FRACTURE is one in which there is a wound through the skin and other soft tissues leading to the fracture.

Cause.—The wound may be produced, 1, *At the same time as the fracture*, either by the violence directly tearing open the soft tissues, or as is more usually the case, by one of the fragments being forced through the skin, either by the original violence or by muscular contraction. 2. *Subsequently to the fracture*, by the patient trying to rise or use the injured limb; or by want of care in removing the clothes, in handling the fracture, or trying for crepitus. 3. *Still later*, by ulceration or sloughing of the soft parts due to inflammation set up by the laceration of the tissues or the pressure of a projecting fragment.

State of the parts.—There may be a mere puncture, with but little if any additional injury to the soft tissues than may be met with in simple fracture; or with or without a large external wound of the skin there may be extensive laceration of the soft tissues, protrusion of one or other fragment, extensive comminution of the bone, implication of a large joint, rupture of the main artery, vein or nerve, and in extreme cases crushing and laceration of the whole of the injured part.

Union of compound fracture.—When the wound is small, and has been closed at once, and the soft parts are but little injured, the process of repair is as a rule similar to that of a simple fracture. When the wound is large, or there is much laceration of the soft tissues or comminution of the bone, suppuration is very liable to ensue, and union is then effected by granulations springing from the ends of the fragments and periosteum, the process being analogous to union of the soft parts by the second intention. The granulations either undergo direct ossification, or first pass through a fibrous, or in some instances a cartilaginous stage. The loose fragments and injured tissues, where the bone is comminuted and the soft parts are much bruised or lacerated, are cast off by the process of ulceration (Fig. 39), before healing ensues. Where, however, a fragment retains its connection with the periosteum, it may not lose its vitality, and may help in the restoration of the bone. Where a large portion of bone is denuded of periosteum it generally dies, and is usually separated as in the ordinary process of necrosis (Fig. 39). It may, however, become embedded in the new bone, and remain a source of irritation for years.

Dangers of compound fracture.—1. Immediate dangers: shock and collapse from loss of blood, which may prove fatal in a few hours; more rarely fat-embolism.

2. Intermediate dangers: septic inflammation, erysipelas, sapræmia, septicæmia, pyæmia, and tetanus. 3. Late dangers: hectic, lardaceous disease, and exhaustion from long-continued suppuration.

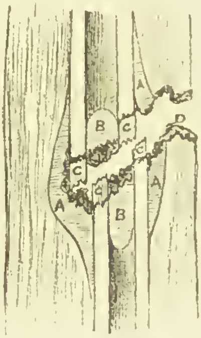


FIG. 39.—Diagram showing process of separation of necrosed bone in compound fracture. A. Ensheathing callus; B. Internal callus; C. Necrosed fragments. D. Granulations lining wound leading to fracture. (After Billroth.)

The Treatment varies according to the state of the parts, the age and health of the patient, and the situation of the fracture. Our aim, when possible, should be to convert a compound into a simple fracture. Thus, when the wound is small, a mere puncture, it should, after being well dusted with iodoform, be closed by a piece of antiseptic gauze, and the case treated as a simple fracture. When the wound is large and lacerated, or other serious injury of the bone, soft parts or neighbouring joint has been sustained, the question of amputation will arise. (See *Amputation in Compound Fracture*, p. 17.) Having, however, determined to save the limb, the indications are—(1) to reduce the fracture, and maintain the fragments at perfect rest; and (2), to promote the healthy healing of the wound. The fracture should be set as described under simple fracture; if the fragments protrude they should be reduced where practicable, sawn off where not, enlarging the wound in the skin if necessary, but taking care not to remove more bone than is sufficient to accomplish the object. Splinters when attached by periosteum should not be removed but simply placed in position. The parts should then be secured in some form of apparatus, so arranged that the wound is not covered by it, but is freely accessible for dressing without disturbing the fragments. The wound should be rendered aseptic by washing out all corners with some antiseptic fluid, and kept freely drained to prevent the decomposition of any extravasated blood and discharges. A careful inspection ought to be made daily to see that the drainage is efficient; and if any collection of pus, which is apt to form in the inter-muscular planes, be discovered, it should be let out with antiseptic precautions and the wound drained. Any portions of bone that may necrose should be removed as soon as loose. When the wound has healed the fracture should be treated in the same way as a simple one. Any complications, as erysipelas, sapræmia, &c., that may occur, must be treated as described in other parts of the book. The *constitutional treatment* is the same as that indicated in other severe injuries. (See also *Simple Fracture.*)

Question of amputation in compound fracture.—In slight and uncomplicated cases, and in those severe injuries in which the limb is completely shattered, the course to be pursued is quite clear; in the one case to spare the limb, and in the other to amputate immediately. But in other instances the question of attempting to save versus amputate becomes one of the most serious and anxious that the surgeon has to decide. No one sign of those to be mentioned below as calling for amputation is in itself alone in every case a sufficient reason for amputating, and when in doubt we cannot do better than follow the rule laid down by Mr. Bryant of 'waiting,' unless the patient be old, in which case immediate amputation should be performed. With this reservation it may be said that we should amputate,—1. If there is great laceration of the soft parts and extensive loss of skin. 2. If there is much comminution of the bone. 3. If the main artery or nerves of the limb are torn. 4. If a large joint is implicated. 5. If the limb is likely to be of little subsequent service from the severity of the injury; and 6. If the patient is old or of a broken-down constitution. The above indications for amputation are more imperative if the fracture involves the lower extremity, especially the femur; but each case must be judged on its own merits, and some surgeons will attempt to save what others condemn. Every legitimate effort should of course be made to save a limb, but we must remember that in attempting to do so we may place the patient's life in danger; and that too often it is a question of a limb versus the life.

If amputation is not performed at once or within the first twenty-four hours, and it then becomes evident that the limb must be sacrificed, the amputation should not as a rule be undertaken till the traumatic fever has subsided, the surgeon watching carefully for the most favourable opportunity that presents itself. The signs calling for amputation during the suppurating stage are:—Extensive suppuration, great sloughing of the soft tissues, inflammation and suppuration of a neighbouring joint, necrosis of large portions of bone, exhaustion, hectic, and lardaceous disease.

COMPLICATIONS OF FRACTURE.—A *simple fracture* may be complicated by any of the *general affections* attending other injuries, as shock, traumatic delirium, tetanus, retention of urine; and by such *local conditions* as, 1, concomitant dislocation, 2, extravasation of blood, 3, rupture of the main artery, vein or nerve, 4, implication of a joint, 5, gangrene from tight bandaging, 6, paralysis from the use of a crutch, or the implication of a nerve in the callus, 7, venous thrombosis, 8, embolism, 9, formation of ulcers or bed-sores over prominences of bone, 10, erysipelas, 11, fat-embolism, and 12, suppuration where there is much laceration of the tissues with giving way of the skin, the fracture then becoming compound.

A *compound fracture* may in consequence of the open wound be complicated, in addition to the above-mentioned affections, by *septic inflammation* and *suppuration*, *necrosis*, *sapræmia*, *septicæmia*, *pyæmia* and *hectic*.

Of these complications of fracture, whether simple or compound, the only ones that need be further mentioned here are the following:—

Fracture combined with dislocation.—In simple fracture the treatment consists in placing where possible the fracture in splints, and then attempting the reduction of the dislocation. Where the dislocated end cannot be replaced the fragments must be allowed to consolidate, and another attempt then made to reduce the dislocation; or the surgeon may try to manipulate the dislocated portion into its socket, and then apply splints to the fracture. In compound fracture this complication is a much more serious one, especially when it occurs in the lower extremity, and involves one of the larger joints. In the knee, ankle, and wrist, amputation, and in the elbow and shoulder, excision, is usually indicated. In the smaller joints the dislocation may be reduced, and the case treated as a wounded joint complicated by fracture.

Fracture implicating a joint.—A simple fracture extending into a joint is not an uncommon accident; indeed the elbow- and knee-joints are always involved in fracture of the olecranon and patella respectively, and the shoulder and hip-joints in the intra-capsular fracture of the neck of the humerus and femur. The injured joint may become stiff or ankylosed, though usually no serious mischief ensues. Suppuration is very rare. The limb in putting up the fracture should be placed, except in the case of fracture of the olecranon, in a position in which it will be of most service should bony ankylosis ensue. Inflammation and stiffness of the joint from fibrous adhesions should be treated in the way described under "Diseases of the Joints." A compound fracture extending into a joint, though more serious, does not necessarily call for amputation or excision, and may be treated in the way described under wounds of joints. But should such be required, excision in the upper extremity and amputation in the lower may be said with certain reservations to be the rule of practice. If an operation is considered unnecessary the case should be treated as a wounded joint, and splints according to the variety of fracture applied.

Fat-embolism is a rare complication of fracture, but is more frequent in the compound than in the simple variety and in bones that have undergone atrophy. It appears that in consequence of the crushing of the medulla, fat-globules gain admission into the veins, and become lodged in the capillaries of the lungs, brain, kidneys, and other organs. It is attended by dyspnœa, either cyanosis or pallor, collapse, irregular action of the heart, and at times by coma and death. Venesection, injection of ether into the veins, and artificial respiration have been suggested in the way of treatment.

Crutch-palsy is due to the pressure of a crutch on the musculo-spiral nerve. The paralysis which chiefly affects the extensor muscles of the fore-arm, giving rise to *dropped wrist*, usually passes off when the crutch is no longer used. Should it not do so, electricity and massage may be employed.

Paralysis or neuralgia sometimes occurs in consequence of the implication of a nerve in the callus. An operation is then at times necessary to liberate the nerve.

Gangrene from tight bandaging is occasionally met with, and is of the moist variety. All bandages should, of course, be at once removed, in the hope that the limb may recover. When the gangrene is thoroughly established, amputation above the seat of fracture, and of course well beyond the gangrene, must be performed.

Extravasation of blood in the tissues is not uncommon in simple fracture, owing to the tearing of some of the smaller blood-vessels by one of the rough fragments. The extravasated blood causes in some instances considerable swelling, and on making its way to the surface gives the part a bruised and black appearance, and frequently causes the cuticle over it to be raised into blebs. These blebs differ from those formed in gangrene in that they are fixed and firm, whilst the latter are movable over the moist and slippery skin beneath. No special treatment is required, the blebs should not be opened, and the blood will gradually be absorbed. In rare instances, suppuration ensues.

Rupture of the main artery or vein occasionally occurs, causing when the skin is unbroken a tense swelling at the seat of fracture, attended in the case of the artery by coldness of the limb, and cessation of the pulse in the arteries below. In compound fracture, rupture of the artery is, as a rule, easily diagnosed, in that pressure on the artery above the fracture stops the bleeding. *Treatment.*—Should the swelling in simple fracture increase in spite of elevation of the limb, cold, and pressure on the main artery above, and gangrene threaten, three courses are open: 1, ligature of the artery above, 2, tying the artery at the seat of fracture, or 3, amputation. In the lower limb amputation is probably, as a rule, the safest course; in the upper limb ligature of the vessel at the seat of fracture may be attempted. But the conditions that call for the adoption of one or other of these methods are too various to discuss here. In compound fracture the vessel should be tied in the wound if possible. If not, amputation will probably, though not invariably, be the right course.

INJURIES OF JOINTS.

CONTUSIONS of joints may be produced by any mechanical violence. They are generally attended with pain and stiffness on movement, and, in severe cases, with swelling from effusion of blood (*hæmarthrosis*), and later, of serous fluid (*synovitis*) into the synovial cavity. If the contusion is neglected, especially in strumous children, acute or chronic inflammatory changes may ensue, leading to destruction of the joint. *The treatment* consists in placing the part at rest on a splint, or in a plaster-of-Paris bandage, and applying cold by means of an ice-bag or Leiter's tubes. Where there is much effusion into the synovial cavity, and consequently considerable tension and pain, aspiration of the joint may be advantageously practised, and pressure afterwards applied.

Sprains.—A sprain is a stretching or partial rupture of the ligaments of a joint without separation of the articular surfaces. Sprains are generally due to a violent wrench or twist of the joint, and are often accompanied by laceration of the tendons and other soft tissues around. They are of most frequent occurrence in the ankle, shoulder, wrist and knee.

Signs and diagnosis.—Severe pain, often localized to certain points, and increased on movement, inability to bear weight on the limb, swelling and ecchymosis from effusion of blood in and around the joint, and later inflammatory effusion into the synovial cavity. The absence of signs of fracture or of dislocation will usually suffice to distinguish a sprain from one or other of these injuries; but where there is much swelling it may be difficult or impossible to make a diagnosis till the swelling has subsided. If in any doubt the injury should be treated as a fracture.

The consequences of a neglected sprain may be very serious, especially in rheumatic and gouty subjects. Thus, as the result of the incomplete absorption of the inflammatory products, the imperfect repair of the torn ligaments, the formation of fibrous adhesions in and around the joint, and the glueing of the surrounding tendons to their sheaths, a strain may be followed by long-continued pain, stiffness, weakness and even fibrous ankylosis of the joint. At times in strumous subjects a sprain may be the starting-point of destructive joint-disease.

Treatment.—The indications are to place the joint at perfect rest till the torn ligaments have had time to heal; to prevent or subdue inflammation; and, should stiffness or ankylosis have ensued, to restore the mobility of the joint by breaking down any adhesions that may have formed. Thus, if seen at once, a plaster-of-Paris or a Martin's bandage should be put on; or if much swelling has already occurred, the parts should be placed on a splint, or in a sling, and either cold in the form of lead-lotion or ice, or heat in the form of hot fomentations applied. For very slight cases, however, a few days' rest, with the part supported by a wet bandage, followed by the use of a stimulating liniment, is all that is usually necessary. The joint in any case should not be kept too long at rest lest stiffness ensue; but as soon as all signs of inflammation have disappeared, passive movements should at once be begun. If stiffness or fibrous ankylosis has already occurred, friction, shampooing, and massage may be tried; or the joint may be forcibly wrenched under an anæsthetic, provided all signs of active inflammation have ceased.

DISLOCATIONS.—A dislocation is the forcible separation of the articular end of a bone from the part with which it is naturally in contact.

Varieties.—Dislocations may be divided into the *Congenital* and the *Acquired;* the latter again into the *Spontaneous* and the *Traumatic.* The *Spontaneous* are those that occur as the result of disease of the joints, and are treated of elsewhere (see *Diseases of Joints*). The *Traumatic*, or accidental dislocations, with which we are here specially concerned, are spoken of as *compound* or *simple* according as they are, or are not, complicated with an external wound leading into the joint; and in either case as *complete* or *partial* according as the articular surfaces are, or are not, completely separated from each other.

The causes of dislocation are predisposing and exciting. *The predisposing causes* may be enumerated as:—1, weakness of the ligaments surrounding the joint from previous dislocation or disease; 2, the shape of the joint—ball-and-socket joints from their extensive range of movement being more easily dislocated than the hinge; 3, middle life—the bones being then strong and capable of resisting fracture and the muscles powerful; 4, the male sex—men being more continually exposed to violence than women. *The exciting causes* are usually, 1, external violence, either direct or indirect, and sometimes 2, muscular action. Examples of each will be met with in the section on special dislocations.

The Signs common to all dislocations are:—1. Alteration in the shape of the joint. 2. Inability to move the limb on the part of the patient, and more or less fixidity to the efforts of the Surgeon. 3. An alteration in the relations of points of bone about the joint. 4. An abnormal position of the end of the displaced bone; and 5. Shortening or lengthening of the limb, or an alteration of its axis. The signs are frequently obscured by swelling in and about the joint, due to extravasation of blood or effusion of synovial fluid. Hence the importance of accurately ascertaining the nature of the injury immediately after the accident, as when swelling has supervened it may not be possible to make a diagnosis till it has subsided.

The *state of the parts* will be more especially referred to under each special dislocation. Here it may be briefly stated that the head of the bone is generally forced through the capsular ligament; whilst other of the ligaments, surrounding tendons, and muscles, may be ruptured or tightly stretched, and the arteries and nerves displaced, pressed upon, or torn. In the ball-and-socket joints the end of the bone will be found either opposite the rent in the capsule, or drawn to some distance from it by muscular contraction. If reduction is effected early, the damaged ligaments and muscles are soon repaired; but the surrounding ligaments remain for some time weak, and thus predispose to re-dislocation. Hence the importance of keeping the parts at rest until firm union of the ruptured capsular and other ligaments has occurred. After reduction a moderate amount of inflammation and serous effusion in and about the joint generally ensues, but usually subsides in a few days if the parts are kept at rest, the joint becoming gradually restored to its normal condition. If rest is neglected, however, the rent in the capsule may not heal, but remain as a permanent hole with smooth edges, allowing the head of the bone to slip in and out of its socket. In some instances, moreover, the inflammation may run into suppuration, which may be followed by ankylosis of the joint.

The impediments to reduction are:—In *recent cases*:—1. The spasmodic contraction of the muscles surrounding the joint. 2. The small size of the rent in the capsule. 3. The hitching of points of bone on each other; and 4. The interposition of ligaments, tendons or muscles. In *old-standing cases*:—1. The formation of adhesions around the displaced bone. 2. The closure of the rent in the capsule. 3. The permanent shortening of the ligaments and muscles; and 4. The alteration of the shape of the articular surfaces, in part from absorption and in part from the formation of new bone. The contraction of the muscles generally increases from the time of the accident; hence every hour the dislocation remains unreduced the more difficult the reduction becomes.

The consequences of non-reduction are either the formation of a new joint, or ankylosis: the former being more common in ball-and-socket joints, the latter in hinge joints. When any movement between the dislocated bones exists, the osseous surface on which the displaced bone rests is converted into a new articular cavity by a process of absorption of the old bone, and the formation of new bone around; the end of the displaced bone becomes adapted by a similar process of absorption to its new socket; and the soft tissues around become condensed so as to form a kind of new capsule. The old socket in the meantime becomes more or less obliterated, its articular cartilage absorbed, and its cavity filled up with fibrous tissue or new bone. The range of movements in the newly-formed joint will at first be limited, but in the course of time under appropriate treatment will become much more free, and a very fairly useful limb may be obtained. When on the other hand the dislocated bone is immovably fixed upon another, the articular cartilage is absorbed, the contiguous osseous surfaces unite, and bony ankylosis is said to ensue. The muscles, moreover, from want of use undergo shortening or partial atrophy and fatty degeneration, leaving the limb in a more or less shrunken and wasted condition.

Treatment.—The indications are:—1. To replace the articular surfaces in contact; and 2. To keep them there till the rent in the capsule has united and the torn ligaments and muscles have had time to heal. Unless the case is seen immediately after the accident, whilst the patient is faint, and the muscles are in consequence relaxed, an anæsthetic had better be given to overcome the resistance of the muscles. The reduction may then be effected either by, 1. *manipulation*, or 2, *extension*.

1. *Manipulation* consists in putting the limb through certain movements of flexion, extension, rotation, and circumduction, varying according to the situation and variety of the dislocation. By means of these movements we endeavour:—1. To overcome the obstacles to reduction by relaxing the stretched ligaments and tendons, and disengaging any hitching points of bone; and 2. To make the displaced head retrace as it were its steps and re-enter its socket. In order to employ manipulation successfully it is essential that the Surgeon should know the anatomy of the part, the direction in which the bone has travelled to reach its abnormal situation, and the probable position of the rent in the capsule.

2. *Extension* is a much less scientific method of reducing

a dislocation, and should never be resorted to, except in certain forms of dislocation which will be mentioned hereafter, till manipulation has been tried. It was the method almost always employed by the older Surgeons, and has for its object the forcible dragging of the displaced end of the bone into its socket, or opposite its socket, into which it is then drawn by muscular contraction. In many forms of dislocation the method is as harmful in practice as it is wrong in principle, since the displaced head, as in some forms of dislocation of the hip, can only be drawn into its socket in this forcible manner by rupturing the resisting ligaments and tendons. In employing extension, traction is made in the long axis of the limb by the Surgeon, either with his hands or by means of a jack-towel secured by a clove hitch to the limb, or if more force is required, by multiplying pulleys. Counter-extension is in the meanwhile made in the opposite direction to the extending force, but in the same straight line, either by the Surgeon pressing with his heel or knee on the part above the dislocation, or by fixing the part with a jack-towel or suitable strap to a hook in the floor or wall. When sufficient extension has been employed to draw the head of the bone opposite its socket, the Surgeon should endeavour to guide it into its place. Before the introduction of chloroform this was usually effected by the contraction of the muscles themselves, after the head had been drawn down by the extending force.

In old-standing cases, before either manipulation or extension is employed, the adhesions, which offer the chief obstacle to reduction, should be first broken down by cautiously rotating or circumducting the limb. When the rent in the capsule has united, the old socket been filled up, and a new joint formed, reduction is of course physically impossible; even then, however, the breaking down of the adhesions may greatly improve the range of motion and consequent usefulness of the limb. In attempting the reduction of a long-standing dislocation, however, great care must be exercised, or irreparable damage may be done.

Among *the accidents attending reduction* may be mentioned:—1. Rupture of the main artery, vein or nerves. 2. Laceration of muscles and tendons. 3. Tearing open the skin and soft tissues, thus rendering the dislocation compound. 4. Fracture of the bone. 5. The evulsion of the limb; and 6. Inflammation and suppuration of the joint and surrounding parts.

How long after a dislocation may an attempt be made at reduction?—Sir Astley Cooper gave the time at between three and four months; but since the introduction of chloroform successful cases have been reported after much longer periods. In an old-standing case the circumstances which should influence us in deciding whether an attempt at reduction should be made are:—the age of the patient, the situation of the dislocation, the presence or absence of pain, and the amount of usefulness of the limb.

The *after-treatment* consists in maintaining the part at rest by suitably-applied strapping and bandages, and in preventing or subduing inflammation by cold, evaporating lotions, &c. The part, however, should not be kept at absolute rest longer than is sufficient for the torn ligaments and other soft tissues to heal lest adhesions form and stiffness of the joint ensue. Passive movements, therefore, should be cautiously begun after a few weeks; and friction, shampooing, or galvanism subsequently employed to restore the tone of the wasted muscles. Where stiffness has occurred the adhesions should be broken down under chloroform, provided there are no signs of active inflammation in the joint.

Treatment of compound dislocations.—The displaced bone should be reduced, the parts placed at perfect rest, and the case treated as a wound of the joint (see *Wounds of Joints*). In consequence of the extensive laceration of the ligaments and other soft tissues reduction is usually quite easy. When a compound dislocation is combined with a fracture of the bone, and there is much laceration of the soft parts, amputation in the lower extremity, and resection of the joint in the upper, will probably be required.

CONGENITAL DISLOCATIONS are those that occur during intra-uterine life, and generally depend upon some malformation of the articular surfaces. They are all very rare; congenital dislocation of the hip, however, being the least so. Little or nothing, as a rule, can be done in the way of treatment. But continuous extension in the horizontal position with pressure over the trochanter has in the case of the hip been attended with considerable success, and Dr. Ogston has recently excised the head of the femur and inserted the neck into a new acetabulum formed by cutting a notch in the ilium.

WOUNDS OF JOINTS.—A joint may be merely punctured, or it may be laid freely open. The wound may be of an incised, lacerated or contused character, and complicated by extensive injury of the surrounding soft tissues, or by dislocation or fracture of the articular ends of the bones. In the latter case, the wound may be further complicated by the protrusion of the dislocated bones or the ends of the fragments.

A wound of a large joint should always be regarded as serious, as owing to the difficulty of securing an efficient drain, and, when once air has entered, of preventing decomposition of the extravasated blood and serous secretion in the synovial pouches, septic or infective inflammation is very liable to be set up, and rapidly run on to suppuration and disorganization of the joint. The peculiar absorptive power of the synovial membrane, moreover, favours the entrance of the chemical products of putrefaction into the system, and the consequent danger of septic poisoning, to which, or to such infective processes as septicæmia or pyæmia, the patient may succumb. Further, should he survive these earlier dangers of blood-poisoning, he is still liable to fall a victim to hectic, exhaustion, or lardaceous disease consequent upon the prolonged drain on the system attending the suppurative inflammation in the synovial membrane, the articular ends of the bones, and the surrounding soft parts.

Medium-sized wounds are the most dangerous, as in such air cannot be prevented from entering, and drainage cannot always be effectually secured. Punctured wounds, when made with a clean instrument and in an oblique direction, may heal under appropriate treatment without any inflammatory or other trouble. Should septic or infective poisons, however, gain admission at the time of puncture, or subsequently through neglect of the wound, or should the joint not be kept properly at rest, a punctured wound may be followed by the most intense inflammation of the synovial membrane, and total disorganization of the joint, with its attendant dangers of blood-poisoning. Extensive and lacerated wounds of joints, when not sufficiently severe to call for amputation or excision, are not necessarily a source of extreme anxiety, as they usually permit of effectual drainage, and under the use of antiseptics may heal up by granulations without giving rise to any serious constitutional disturbance. In such cases, however, bony ankylosis will generally ensue, though in some instances the cartilages may escape destruction, and a fairly movable and useful joint may be obtained.

Signs.—When the joint is laid freely open the nature of the injury is obvious, and any displacement or splintering of the bones can be .ascertained by examination with the finger. When the wound is of a punctured character and the incision in the skin is some distance from the joint, the signs are not always so apparent. In such cases an account of the depth to which the instrument penetrated, and the direction in which it appeared to run, will help us to determine whether the synovial membrane has been entered. The escape of a glairy fluid like white of egg—the synovial secretion—will make the diagnosis certain. If in doubt, the case should be treated as if the joint had been opened, but on no account should the wound be probed for the purpose of settling the point. Should inflammation ensue the signs will be the same as those of acute arthritis (see Diseases of Joints).

The treatment will depend on the size and character of the wound, the joint affected, the nature of the complications, and the age and constitution of the patient. The chief indications are to prevent inflammation and its attendant consequences, or if the injury is of a very severe character, to endeavour to save the patient's life by the sacrifice of his limb. Thus, if the wound is small and uncomplicated, an attempt should be made to convert it into a subcutaneous wound by sealing it with colodionized lint, or better by placing over it an antiseptic dressing, after having first thoroughly cleansed the skin and rendered it aseptic. One or more silver or chromic gut sutures may first be inserted if the wound is too large to be closed in this way. The limb should be then placed on a splint at perfect rest, and cold applied by means of an ice-bag or by Leiter's tubes. Should inflammation follow, half a dozen leeches should be placed over the joint, and warm applications be substituted for the cold; whilst, should the local and constitutional disturbance increase and the joint become distended, aspiration should be practised to relieve tension, opium given to soothe the pain, and the treatment persevered in. If, however, pus is withdrawn by the aspirator, the joint should be laid freely open, drained, dressed antiseptically and placed in the position in which, should ankylosis ensue, it will subsequently be of most use. If, notwithstanding free incisions, the suppuration continues, continuous irrigation with some weak antiseptic fluid may be tried, or the whole limb kept continuously in a hot bath, the patient if necessary, as in the case of the knee, being himself immersed. Should signs of sapræmia or exhaustion from hectic set in, amputation must be performed.

Larger wounds of joints, especially when lacerated, should be thoroughly cleansed with antiseptic lotions, well-drained, and dressed antiseptically. A counter-opening at a dependent spot may in some cases be advantageously made, as for instance in the popliteal space in wounds of the knee, and a tube passed through the joint. Where there is extensive laceration of the soft parts, much comminution of the bones, or other complications of such a nature as to render it doubtful whether a useful limb can be obtained, the question of amputation or excision must be raised. In deciding on the propriety of an operation the Surgeon will be influenced by the situation of the joint, and the probable power of the patient, either on account of his age or the general state of his constitution, to stand the acute inflammation and prolonged suppuration which must almost necessarily ensue if the limb is not removed. In a work of this character such a difficult question cannot be adequately discussed. Briefly it may be said, that an injury which in the elbow might be treated in the ordinary way or by excision of the joint, would in the knee probably call for amputation; that a wound of the wrist is generally more serious than one of the ankle; and that the sacrifice of the limb is required for a much less severe wound of the knee than of the ankle.

INJURIES OF MUSCLES AND TENDONS.

CONTUSIONS OF MUSCLES are very common as the result of falls, blows, kicks, or other violence. They may vary from a slight bruising with or without tearing of the muscle-fibres and blood-extravasation to complete pulping of the muscle. *Signs.*—In the slighter cases there is dull aching pain increased on movement, ill-defined and deep-seated swelling, and later, ecchymosis as the blood makes its way to the surface. Some stiffness or loss of power from partial atrophy frequently follows, and occasionally inflammation and abscess. Severe cases are frequently associated with other injuries of the part, as fracture of a bone, laceration of a large blood-vessel, &c. *The treatment* consists in keeping the part at rest with the muscle as much as possible relaxed, and in preventing inflammation by cold, lead and opium lotions and the like. Shampooing, massage, and galvanism may subsequently be necessary to restore any loss of power that may ensue.

WOUNDS OF MUSCLES may be incised, lacerated, punctured, or contused. When the wound is made transversely, the divided ends, which gape widely, must be approximated by placing the limb in such a position as will relax the muscle, and then sutured by animal ligature. When the wound is deep or parallel to the fibres a drainage tube must be inserted to prevent the retention of the discharge by the bulging of the muscle. Union takes place by fibrous tissue.

RUPTURE OF MUSCLE may occur from a sudden and violent spasmodic action, or during vomiting, tetanus, or delirium. As examples may be mentioned rupture of the rectus abdominis in labour, the biceps in raising weights, the supinator longus and gastrocnemius in lawn-tennis, the quadriceps extensor at football, and the adductors of the thigh in riding. A sensation of tearing is often felt at the moment of rupture, followed by pain and, if the rupture is complete, by loss of function. The rupture is indicated by a gap, above and below which is felt a hard swelling formed by the ends of the retracted muscle; or blood is extravasated between the ruptured ends occasioning a hæmatoma. The *treatment* consists in approximating the divided ends as much as possible by position and by suitable bandages and splints, and in applying ice and evaporating lotions to control the blood-extravasation and to prevent inflammation. If a blood-tumour forms it should not be opened, unless suppuration occurs.

WOUNDS OF TENDONS may be divided into the subcutaneous and the open. The former are discussed under *Tenotomy.* When a tendon is divided in an open wound, its cut ends should be approximated by placing the parts on a splint in such a position that the muscle is as much as possible relaxed, and the divided ends then sutured by animal ligature. In long-standing cases an attempt may also be made to unite the cut tendon if the patient's general state of health is favourable, and there is no evidence of extensive destruction or of adhesion of the tendon to the neighbouring structures having occurred.

DISLOCATION OF A TENDON from its sheath or groove without fracture or other injury occasionally occurs from a sudden twist or strain. It is indicated by pain and partial or complete loss of function of the affected muscle, swelling and ecchymosis; whilst on examination the displaced tendon may sometimes be felt in its abnormal situation. The injury is most common about the ankle, and in the fore-arm, back and neck. The *treatment* consists in replacing the tendon by manipulation, breaking down any adhesions that may have formed, and retaining it in place (which is often difficult) by a suitably-applied pad and bandage, or in the case of the ankle or wrist by a plaster-of-Paris bandage, and subsequently by a leather support.

RUPTURE OF A TENDON may occur as the result of external violence or during some sudden and involuntary muscular action, and is very common in the plantaris and tendo Achillis, and somewhat less so in the biceps (see Injuries of the Upper and Lower Extremity). The tendon, except when the ends become widely separated, as generally happens in the case of rupture of the long tendon of the biceps, usually unites readily on the ends being approximated and kept at rest in that position.

EVULSION OR TEARING OUT OF A TENDON with part of its muscle occasionally occurs as the result of catching the finger or thumb in a machine, on a hook, &c. Part or the whole of a digit is usually torn off, bringing away with it the flexor tendon, this being more firmly attached to the bone than the extensor.

INJURIES OF ARTERIES.

CONTUSION OR BRUISING of an artery without laceration or other injury of its coats is of occasional occurrence, and is said to be followed by contraction and permanent diminution in the size of the vessel, and even by gangrene of the limb. Little that is definite, however, is known of this injury.

RUPTURE OR SUBCUTANEOUS LACERATION of an artery may occur as the result of any severe violence, but is perhaps most often due to the passage of a wheel over a limb, incautious attempts to reduce an old dislocation of the shoulder, and excessive violence in breaking down adhesions in stiff joints.

1. *The rupture may be partial, i.e.*, the internal and middle coats only may be torn. In such a case the external coat may subsequently yield to the pressure of the blood, thus laying the foundation of an aneurism; or the internal and middle coats may be folded inwards into the interior of the vessel, obliterating its calibre, and in this way may cause, especially if the vein is also injured, gangrene of the limb.

2. *The rupture may be complete, i.e.*, all the coats may be torn across. Here in a similar manner the artery may become occluded without any hæmorrhage; or blood, often in enormous quantities, may be poured out into the tissues of the limb. In either case gangrene may ensue, especially if the vein is also ruptured, and the injury occurs in the lower extremity. Sometimes the extravasated blood, particularly in the upper extremity, may become encysted, a sac being formed for it by the inflammation and condensation of the surrounding tissues. This condition is called a *circumscribed* traumatic aneurism in contradistinction to *diffused* traumatic aneurism, the term sometimes applied to the injury when the blood is simply extravasated into the tissues, though in this latter case the name ruptured artery is more appropriate.

The *symptoms* vary according to the nature of the injury. When the artery becomes occluded there will be pain at the seat of rupture and cessation of the pulse below, while later gangrene will probably, though not invariably, ensue. Should the artery not be occluded blood in large quantities escapes into the tissues, giving rise to a rapidly-increasing swelling, in which no pulsation can be detected, although a bruit may sometimes be heard; the limb becomes cold, livid, and swollen, and the pulse, as a rule, can no longer be felt in the arteries below. When the extravasation is very large constitutional symptoms of hæmorrhage will also be present, and signs of gangrene, if the ruptured artery is in the lower limb, will probably soon supervene, since not only is the main arterial supply cut off, but the collateral flow and venous return are also impeded by the pressure of the extravasated blood on the collateral arteries and veins. On the other hand, should the blood, as occasionally happens in the upper limb, become encysted, the swelling will slowly assume the characters of an ordinary aneurism.

Treatment.—(a). *When the artery is occluded* all that can be done is to endeavour to prevent gangrene occurring by maintaining the warmth of the limb till the collateral circulation has had time to become established. Should gangrene occur amputation must be performed as soon as a line of demarcation has formed. (b). *When blood in large quantities is extravasated into the tissues* the treatment will depend on the situation of the ruptured artery. Thus, in the case of the popliteal, amputation is usually called for, especially if the vein is also ruptured, as gangrene, for the reasons stated above, will almost invariably ensue if the main artery is tied either above or at the seat of rupture. In the case of the axillary, however, where the collateral circulation is much more free, the ruptured artery may be cut down upon and secured above and below the bleeding spot.

WOUNDS OF ARTERIES may be divided into the penetrating and the non-penetrating.

1. *The non-penetrating* are those in which either the outer only, or the outer and middle coats, are notched or torn. Here the wound may heal, or the uninjured coat or coats may ulcerate, give way, and hæmorrhage ensue, or may gradually yield, as may also the cicatrix left on the healing of the wound, to the pressure of the blood, and lead to the formation of an aneurism.

2. *The penetrating* are those in which the interior of the artery is laid open. In this case much will depend upon the size of the artery, and whether it is completely or only partially cut across, and upon the direction and size of the wound.

(a). *Wounds of large arteries*, as the aorta or pulmonary artery, whatever their nature, are usually immediately fatal.

(b). *Wounds of arteries of the second and third degree*, as the femoral and brachial. If the artery is *completely divided*, and the edges of the wound are cleanly cut, repeated hæmorrhages rapidly terminating in death will generally ensue; but if the edges are uneven and ragged, as in the avulsion of a limb by machinery or by a cannon-ball, tho external coat becomes twisted up, and the middle and internal retract and contract, a clot forms within the vessel, and no hæmorrhage occurs. If the artery is *partially divided* and the wound is made transversely to the long axis of tho vessel the longitudinal tension of the elastic coat causes the wound to assume a diamond shape, and severe hæmorrhage will ensue; but if tho wound is made parallel to the long axis of the vessel, and is small (a mere puncture) it may heal by adhesive inflammation. In the latter instance the cicatrix may remain permanent, or it may subsequently yield, producing a traumatic aneurism.

(c). *Wounds of medium-sized arteries*, as the radial and tibials, are attended when the vessel is *completely and evenly divided* by sharp hæmorrhage, followed by syncope, and temporary arrest from the formation of a clot. The artery may then become permanently occluded; usually, however, as the heart's power is restored the clot is washed away and hæmorrhage recurs. In this way hæmorrhages, alternating with temporary arrests, continue until death ensues from exhaustion. When the edges of the wound are *uneven*, or the artery is only *partially divided*, the effects are similar in each case to those described above in arteries of larger size.

(d). *Wounds of small arteries.*—If the artery is *completely divided* it will usually become occluded in the way described under nature's method of arresting hæmorrhage (p. 115); but if only *partially divided* such occlusion does not as a rule take place, and repeated hæmorrhages follow. Complete division will then often suffice to cause its occlusion, a plan which was frequently resorted to when bleeding from the temporal was practised.

When the wound through the soft tissues leading to a wounded artery is small or of a punctured character, the superficial part of the wound may close, whilst the blood continues to be extravasated from the wounded vessel into the deeper part, where it may become encysted from the condensation of the soft tissues around (*circumscribed traumatic aneurism*).

TREATMENT OF WOUNDED ARTERIES.—1. When an artery is seen spouting in an open wound a ligature should at once be applied to the bleeding end. Other methods of securing the vessel, as torsion or acupressure, may of course be used if preferred; but as the ligature is almost invariably used at my own school, I shall, to prevent repetition of what has been already said under arrest of hæmorrhage (p. 118), speak of ligature only in the context.

2. When the end of a large artery is seen pulsating, but not bleeding in consequence of it having been *torn* across, I should, myself, apply a ligature to it as a precaution, though by some this would not be considered necessary.

3. When an artery is exposed for some distance in its continuity two ligatures had better as a rule be applied and the artery divided between them, especially if it be notched or bruised.

4. When an artery has ceased to bleed, even though the hæmorrhage may have been sharp, the wound should on no account be enlarged for the purpose of tying the bleeding vessel, unless it can be seen or felt; since not only may it not bleed again, but as the bleeding has ceased it may also be difficult or impossible to find it. In such a case, however, especially if the patient is much collapsed, he should be watched for the first sign of any return of the hæmorrhage, firm pressure in the meantime being applied over the wound, and where practicable over the course of the main artery above and below. The whole limb, moreover, should be carefully bandaged from below upwards.

5. When the hæmorrhage is moderate and clearly arterial, the external wound small, and the artery not seen, pressure should be applied in the way mentioned above, and will probably suffice.

6. When the bleeding is severe and evidently arterial, and the external wound is still open, whether the wound be deep, recent, inflamed, or sloughing, the well-established rule, to which, however, there are of course exceptions, is *to cut down upon the bleeding point and to tie each end of the artery if divided, or above and below the wound if punctured or only partially cut across.* To do this it is generally sufficient to enlarge the wound in the soft tissues; but where the wound is on one side of the limb and the bleeding apparently comes from an artery on the other, a probe should be passed through the wound, its projecting point cut down upon, and the bleeding artery sought through this incision and tied as above. The object of this procedure is to prevent the necessity of making a very large wound.

The reasons for tying an artery at the place where it is wounded are:—1. It is often impossible to determine, without cutting down upon it, what artery is bleeding, and should the alternative plan of securing the main artery higher up be adopted, the wrong artery after all may be tied and the bleeding continue. Thus, for example, in a supposed wound of the femoral it might be the profunda, or even a small muscular branch that was bleeding. 2. Even supposing the main trunk were the one wounded the blood might still be carried by the collateral vessels into the artery beyond the ligature, either above or below the wound in the vessel, and bleeding recur from either the proximal or distal end (Fig. 40). 3. Should, moreover, ligature of the main artery higher up thus fail to arrest the hæmorrhage, not only will the patient be further reduced by loss of blood, but the subsequent ligature, which will then probably in the end have to be applied to the bleeding artery in the wound, may induce gangrene of the limb. 4. Tying the main artery above is in itself in some cases a more dangerous and difficult proceeding than enlarging the wound.

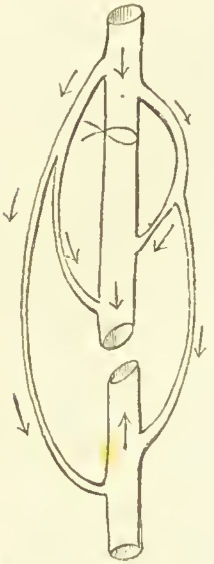


FIG. 40.—Diagram to illustrate the manner in which, after a ligature has been applied at a distance from a wound in an artery, the blood may be carried back again into the artery above and below the wounded spot by collateral vessels. The arrows indicate the direction of the blood current.

The reason for ligaturing both ends of the vessel if it is divided, or above and below the wound if it is merely punctured or only partially cut across, is that ligature of the proximal end only is insufficient to arrest the hæmorrhage, since the blood, as seen in (Fig. 40), may be carried round by the collateral channels into the artery below the wound and may thence escape by the open distal end.

In some instances, the above rule of cutting down upon and tying the artery at the wounded spot cannot be carried out. Thus, where the artery is inaccessible, as in punctured wounds of the tonsil, or about the angle of the jaw; or where important structures would be damaged by enlarging the wound, as the tendons in the palm of the hand in wounds of the palmar arch, it may be necessary to tie in the former case one of the carotids, in the latter the brachial. Moreover, it may at times be safer to remove a limb than to search for the bleeding vessel, as for instance in wounds of the posterior tibial artery in the upper third of the leg, especially if the injury is complicated by fracture. Again, it may not only be found impracticable to ligature the artery at the wounded spot, but also impossible to tie or even compress the main vessel nearer the heart. Here all that can probably be done is to trust to pressure firmly applied to the wound.

Whilst cutting down upon a bleeding artery hæmorrhage should be restrained by the use of an Esmarch's bandage, or by the tourniquet or the fingers applied to the main artery above the wound; and in the case of a wound of the external iliac or gluteal by Davy's lever passed up the rectum and made to compress the common iliac. Where it is impracticable to control the bleeding in any of these ways the wound, if necessary, should be sufficiently enlarged to admit one or two fingers, and the bleeding vessel having been recognized by the escape of warm blood should then be compressed, the wound further enlarged, and the artery secured with the aid of an assistant before the finger is removed from the bleeding aperture.

Should gangrene ensue after ligature, and spread rapidly, amputation must be performed at the seat of ligature; but if it involves only one or two fingers or toes, or spreads slowly, a line of demarcation should be waited for before amputating.

TRAUMATIC ANEURISM.—Two forms are described, the diffuse and the circumscribed.

The *diffuse* is practically a ruptured or wounded artery with extravasation of blood into the tissues. There is no attempt at the formation of a sac, and the term aneurism applied to it is misleading. (See Ruptured Artery.)

The *circumscribed* may be formed in several ways, as already stated under Rupture and Wounds of Arteries. Thus, 1. An artery may be wounded, pressure be applied, the external wound heal, and blood slowly escape into the tissues. 2. An artery may be wounded, heal, and the cicatrix subsequently yield. 3. An artery may without external wound be punctured by a fragment of fractured bone, or torn in reducing a dislocation, and blood in either case be extravasated into the tissues. 4. An artery may be wounded but not penetrated, and the uninjured coat or coats may yield to the pressure of the blood. In all of these cases the soft tissues around become condensed and form the sac of the aneurism. Where the aneurism is produced by the yielding of any portion of the arterial coat, this at first will form the sac, but sooner or later it will give way, and the sac will then be formed by the condensation of the soft tissues around, as when the blood escapes directly into the tissues. The course, termination, and signs of a circumscribed traumatic aneurism are similar to those of a spontaneous aneurism. The *treatment*, however, inasmuch as the artery in the neighbourhood of the sac will probably be healthy, differs from the treatment of a spontaneous aneurism, in that the artery may be tied immediately above the sac, or the sac may be laid open and the vessel tied above and below. Thus, if the injured artery is small, it may be tied above and below; if large, immediately above, unless the aneurism threatens to burst, under which circumstances the aneurism should be laid open and the artery tied where it enters and leaves the sac.

ARTERIO-VENOUS ANEURISM is a pulsating tumour depending upon an abnormal communication of an artery with a vein. There are two kinds: in one the communication between the artery and the vein is direct (Fig. 41A.), and the arterial blood is forced into the vein at each beat of the heart, causing its walls to be dilated into a fusiform or sac-like swelling (*aneurismal varix*); in the other (Fig. 41B), the blood first passes into a small aneurism formed by condensation of the tissues between the artery and vein and thence into the vein, the dilatation of the vein being consequently less than in the preceding variety (*varicose aneurism*). Both forms may occur spontaneously, but are usually the result of some injury, as a stab, wounding the walls of both vessels. The lesion was of common occurrence at the bend of the elbow when venesection was in vogue, the lancet passing through the median basilic vein and bicipital fascia into the subjacent brachial artery. *Signs.*—An aneurismal varix gives rise to a pulsating tumour in which a peculiar bruit, compared to the buzzing of a fly in a paper box, is heard. The artery is dilated and thinned above owing to the impediment to the circulation, and is smaller below; whilst the vein is dilated, especially above, and pulsates. In varicose aneurism, in addition to the above signs, which are common to both forms, an ordinary aneurismal bruit can be heard. *Treatment.*—In aneurismal varix some form of elastic support should be applied, or if the swelling is increasing, the artery tied above and below its point of communication with the vein. In the varicose aneurism pressure may first be applied to the artery above the sac, combined with direct pressure on the sac. If this fails the artery must be tied above and below the sac, since if left to nature there is grave danger of rupture and hæmorrhage. When the carotid or the femoral artery and the adjoining veins are the subject of the lesion, no operative treatment as a rule should be undertaken unless the lesion is recent, and the blood as well as passing into the vein is being likewise extravasated into the tissues, and threatening to break through the external wound. In such a case, should pressure applied to the main artery and over the site of the wound fail, the artery must be cut down upon and tied above and below the wound. Unless pressure controls the hæmorrhage from the vein a ligature must be placed on the wound in its wall, or if the wound is too large to admit of this being done, the whole vein must be tied above and below the wound.

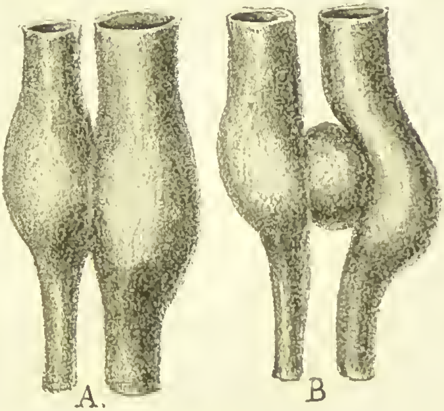


FIG. 41.—Diagram of arterio-venous aneurism. A. Aneurismal varix. B. Varicose aneurism.

INJURIES OF VEINS.

RUPTURE or subcutaneous laceration of a vein occasionally occurs from causes similar to those producing rupture of an artery, an accident moreover with which it is frequently associated. When the vein is of large size much blood may be extravasated into the tissues and may produce gangrene by pressure on the vessels carrying on the collateral circulation, though such a result is much less common than after rupture of an artery. The blood, except when the extravasation is large, is usually absorbed, but may break down and suppuration ensue.

WOUNDS.—Punctured and incised wounds when small and parallel to the long axis even of large veins readily heal by adhesive inflammation without obliteration of the lumen of the vessel. At times, however, a clot may form in the wound, and successive layers be deposited upon it till ultimately the vein is occluded. When a vein is completely cut across, as in amputations, it usually collapses as far as the next pair of valves, a clot forms as high as the first collateral branch, and the vein becomes permanently occluded in a way similar to that described under Healing of Wounded Arteries. In consequence, however, of the vein-wall containing less elastic and muscular tissue than an artery, bleeding sometimes continues unless stopped artificially.

Treatment.—When the wound is a mere puncture in the continuity of the vein, unless it is found that pressure will control the hæmorrhage, the coats should be nipped up by forceps and a ligature applied. If a vein continues to bleed during an amputation it should be tied like an artery. A large wound, or one made in the longitudinal axis of a large vein, necessitates ligature of the vein in two places, and the division of the vessel between the two ligatures.

The *dangers of wounds of veins* are:—1. Hæmorrhage. 2. Inflammation of a septic character, and the attendant risks of blood-poisoning from the detachment of the infected clots. 3. Entrance of air.

ENTRANCE OF AIR into veins is fortunately a rare accident. It sometimes happens in operations about the root of the neck where the disposition of the cervical fascia prevents the veins collapsing and thus allows air to be sucked in during inspiration. The air is known to have entered the vein by the hissing sound during inspiration, the escape of frothy blood from the vein on expiration, and the state of collapse into which the patient immediately falls. On listening over the heart a peculiar churning sound can be heard. Death in fatal cases usually occurs in a few minutes and is due to the admixture of blood and air preventing the circulation through the capillaries of the lungs and so causing distension and paralysis of the right side of the heart. *Treatment.*—The finger should at once be placed over the hole in the vein to prevent more air entering, and a clamp or ligature applied as soon as practicable. Pouring water into the wound has been suggested both as a means of preventing the further entrance of air during inspiration, and of allowing that which is already in to bubble out during expiration. The patient should be placed with his head low to ensure a sufficient supply of blood to the brain, and for the same purpose the arteries of the extremities should be compressed, whilst injections of ether or brandy should be given subcutaneously to stimulate the heart. Artificial respiration should not be performed till the vein is secured, lest more air be sucked in. To guard against the accident the veins should be clamped before division, and in removing a tumour traction should not be made at the moment the vein is severed.

INJURIES OF NERVES.

WOUNDS OF NERVES.—A nerve may be completely or partially divided, and the wound may be of an incised, lacerated, contused, or punctured character.

Pathology.—After complete division of a nerve the divided ends slightly retract, and should union not be effected, either naturally or by surgical means, the portion of nerve below the injury being cut off from its trophic centre undergoes atrophy and degenerates throughout its entire length (*Wallerian degeneration*). In the meanwhile the portion of nerve immediately above the wound is converted into a bulbous swelling by the proliferation of the fibrous tissue of the sheath and its prolongations within the nerve. The nerve fibres within the bulbous end, being compressed by the newly-formed fibrous tissue, undergo atrophy and degeneration, but the rest of the nerve above the injury remains unimpaired. On microscopic examination of the bulbous end, numerous young nerve fibres are seen in the fibrous tissue (Bowlby). Should union on the other hand occur, the process by which it is effected is briefly as follows:—Inflammatory material is thrown out between the divided ends, and forms a delicate fibrous network bridging the gap; into this the axis-cylinders of the upper end are said to grow out and unite with the degenerated axis-cylinders in the lower end, which then becomes gradually restored from above downwards. By some it is believed that new axis-cylinders "are developed from the nuclei of the sheath of Schwann in both the proximal and peripheral ends" (Bowlby). The exact manner, however, in which the union and regeneration of the nerve is brought about is hardly accurately known. When a nerve is only partially cut across, the divided portions may unite in the way above described, or they may become involved in the scar resulting on the healing of the soft tissues and then prove a source of much irritation to the rest of the nerve.

The effects of wounds of nerves in addition to the degeneration of the portion below the wound are:—1. Paralysis of motion and sensation of the parts supplied by the nerve. 2. Subsequent wasting, atrophy, and fatty degeneration of the paralysed muscles. 3. Certain trophic changes in the tissues whose nutrition is presided over by the injured nerve, such as a glazed, smooth, cold and bluish-red condition of the skin, falling off of the hair, cracking and deformity of the nails, local ulcerations and gangrene of the fingers, &c. 4. A marked diminution of the temperature of the part, which may be preceded for a few days or even a few weeks by a slight increase of two or three degrees. 5. Affections of the joints resembling rheumatism, and apt to terminate in more or less complete ankylosis. 6. Ascending neuritis, which is attended by severe pain in the cicatrix, pain shooting up the nerve, and pain in the area of distribution. 7. Changes in the nerve-centres of a functional or an organic nature (rare).

Signs.—The immediate symptoms are loss of function in the parts supplied by the nerve, viz., local anæsthesia, muscular paralysis, or loss of special sense, according as a motor, sensory, or nerve of special sense is injured. In the case of a mixed nerve both motion and sensation will be lost; but sensation in some instances may be partially restored in a few days through anastomosing branches from other nerves. The remoter symptoms are wasting of the muscles, and the trophic changes of the skin, nails, &c., already alluded to, and sometimes pain in the cicatrix, and in the course of the nerve and its peripheral distribution. The muscles exhibit to electrical tests the *reaction of degeneration, i.e.,* they do not respond to the Faradic current, but contract on the application of a continuous current of less strength than that necessary to cause the contraction of normal muscles; the contraction elicited, moreover, is slow, long, and tetanic; and the sequence of polar reaction is altered (*ACC.* > *CCC.* instead of *CCC.* > *ACC.*). Their response, however, to the continuous current becomes less and less till they finally cease to contract at all. As a consequence of the degeneration of the affected muscles their opponents undergo adaptive shortening, thus producing various deformities, as for example the hammer fingers (*main en griffe*) seen after division of the ulnar nerve.

The *treatment* varies according as the wound of the nerve is recent or of long standing. In the former case the nerve should be sought in the wound, the divided ends sutured, the limb placed at rest on a splint in such a position that the united ends are not subjected to tension, and every effort subsequently made to obtain healing of the wound of the soft parts by the first intention. If the divided ends of the nerve are lacerated or contused, the injured portions should be cleanly cut away before applying the sutures. If the nerve is only partially divided the divided parts should be sutured. The sutures may consist of chromicized catgut, kangaroo-tail tendon, or fine China twist. They should be passed with a small curved needle through the sheath of the nerve in four or five places. At St. Bartholomew's one of the sutures is generally passed completely through the nerve, a quarter of an inch from the divided ends, to ensure a better hold. In every recent wound it should be as much a matter of routine to suture large nerves if divided, as to tie wounded arteries. If the nerve does not unite an attempt may be made to procure union after the wound has healed, as may also be done in long-standing cases of non-union, though many months or even a year or two may have elapsed. An incision over the ununited ends should be made parallel to the nerve, the bulbous upper end of which can generally be felt through the soft tissues. The ends, which may have retracted so as to be as much as an inch apart, should be sought, the bulbous end shaved away little by little with a sharp scalpel till plenty of nerve-fibres are seen on the surface of the section, the lower end also refreshed and the two united in the manner described above. Where the ends are embedded in much cicatricial tissue they should be freed by careful dissection, and when much separated stretched so as to bring them into apposition. If the nerve is only partially divided, and the divided portions are bound down by cicatricial tissue, the injured segment of nerve, in its entire thickness, should be cut away before applying the sutures. In some instances sensation may return within twenty-four hours of suture; but it may be more than a year in long-standing cases before the function of the nerve is restored. In the meanwhile the nutrition of the parts supplied by it should be promoted by warmth, and the muscles prevented as much as possible from degenerating by galvanism, massage, friction, and passive movements.

Transplantation of nerves or nerve-grafting.—Recently Mr. Mayo Robson has succeeded in transplanting a portion of the posterior tibial nerve taken from an amputated limb in the gap left in the median nerve on the removal of a tumour. An attempt to restore the function of the nerve in this way may be made where the proximal and the distal ends of a divided nerve cannot be brought into apposition, as, for instance, after a portion of nerve has been destroyed in a compound fracture, or after a portion of nerve, damaged by the contraction of cicatricial tissue, by the formation of callus or by the growth of a tumour in its substance, has been removed. The conditions for success are :—Great care in dissecting out and handling the nerve, its immediate transference, the employment of a single suture at each end, the avoidance of all tension, strict asepsis, and immediate union of the wound of the soft parts.

SUBCUTANEOUS RUPTURE of a nerve is rare, but is occasionally met with as the result of a severe twist or wrench. I have seen it twice in the peroneal nerve where it winds round the head of the fibula. It is attended by severe pain at the time of injury, perhaps also referred to the periphery of the nerve, and the gradual formation of a bulbous swelling on the nerve immediately above the rupture. The same effects follow as in division of a nerve in an open wound. The *treatment* is also similar.

COMPRESSION of a nerve occasions numbness and tingling, and, if severe and prolonged, partial or complete paralysis of the parts supplied by it, and the series of changes described in the last section. As examples may be mentioned crutch-palsy, due to the pressure of a crutch upon the large nerves in the axilla; the dropped hand from the involvement of the musculo-spiral nerve in the callus in fracture of the humerus; the tingling, numbness and partial paralysis sometimes following dislocations of the shoulder from the pressure of the head of the displaced bone on the brachial plexus; the pain caused by the pressure of a tumour on a nerve; the "pins and needles" felt in the feet after sitting on the edge of a chair from compression of the sciatic nerve, &c. The *treatment* consists in releasing the nerve from the compressing agent if practicable. If a wound of the soft tissues is necessary to accomplish this object, healing without suppuration should be obtained if possible, as otherwise the nerve may become again compressed by the resulting scar-tissue.

CONTUSIONS OF NERVES.—A familiar example of this injury is a blow on the ulnar nerve, as it lies behind the internal condyle. There is intense pain at the spot struck, and shooting pains and "pins and needles" in the parts supplied by the nerve. These symptoms pass off shortly, but occasionally they may be more severe and last for several weeks, in which case there is probably some effusion of blood in the nerve. In rare instances ascending neuritis, persistent neuralgia, or even paralysis, and changes similar to those observed after complete division of a nerve may follow.

FOREIGN BODIES IN NERVES.—A portion of a needle broken off in a nerve, the lodgment of small shot from a gun accident, &c., may give rise to inflammation of the nerve, persistent irritation and pain at the injured spot, spasm in the muscles, and pain or tingling in the parts supplied by the nerve. Such accidents have occasionally been followed by epileptiform convulsions. The *treatment* is to cut down upon and remove the foreign body.

SECTION IV.

Diseases of Special Tissues.

DISEASES OF BONE.

Diseases of bone may be classified into those depending upon—1. *Inflammation and its results.* 2. *Simple defect or increase in nutrition.* 3. *Constitutional dyscrasia;* and 4. *New growths.*

I. *Inflammation and its Results.*

Inflammation of bone.—In studying inflammation of bone you should bear in mind that it is in the soft parts of bone,—the periosteum, the medullary membrane, and the delicate vascular connective tissue which pervades the Haversian canals and cancelli that the inflammation occurs, and that the pathological process, though somewhat modified by the hard and resisting nature of the osseous framework, is essentially similar to that which occurs in the soft tissues. The same vascular and exudative changes ensue, and are accompanied by the like phenomena of redness, heat, pain and swelling. The inflammation, moreover, may be of a simple and local, or of a diffuse and septic or infective character, and variously influenced by such constitutional states as syphilis, struma, gout, and rheumatism, or by the presence of miliary tubercle. Further, it may terminate in resolution, or in sclerosis, caries, necrosis, or suppuration, conditions comparable to fibroid thickening, ulceration, gangrene and suppuration of soft parts. On account of the intimate connection of the bone with the periosteum and medullary membrane inflammation is seldom limited to any of these structures, and when one is affected the others generally soon become also involved. According, however, as the inflammation begins in, or is chiefly confined to the periosteum, medulla or bone, the disease for convenience is spoken of as periostitis, osteo-myelitis, and osteitis.

PERIOSTITIS, or inflammation beginning in or chiefly affecting the periosteum, may be acute or chronic.

ACUTE PERIOSTITIS may occur (1) as a simple local, or (2) as a diffuse and infective inflammation; the former being generally the result of some local injury, the latter of some severe constitutional dyscrasia.

ACUTE SIMPLE PERIOSTITIS is generally the result of a local injury, and occurs most frequently in the tibia, that bone being most exposed to injuries, as kicks, blows &c. *Pathology.*—The inflammation is of the ordinary, simple kind, and usually terminates in resolution; occasionally, however, suppuration occurs attended by some superficial necrosis, or the inflammation may become chronic. *Symptoms.*— There is acute throbbing pain, increased on pressure, and worse at night. If the bone is superficial, as in the case of the tibia, there may be also local redness of the skin, œdema, heat, and evident swelling of the bone, followed, should suppuration occur, by fluctuation. *Treatment.*—Rest, elevation of the part, and the application of cold, with perhaps a few leeches, will usually suffice; but should suppuration threaten, hot poultices should be put on, and a free incision made as soon as pus has formed. Opium may be required to relieve pain.

DIFFUSE INFECTIVE PERIOSTITIS, sometimes known as "acute necrosis," is always of a grave nature, as not only may it lead to the death of large portions of bone, but it may also terminate fatally from septicæmia or pyæmia.

Cause.—It generally occurs in debilitated children following upon some slight injury, as a blow or fall upon the part. It is, however, probable that it depends upon some constitutional mischief, and that such local influences as injury, cold, &c., although they may act as slight exciting causes, have little or nothing to do with it. It also occurs as a sequela of the continued fevers. From the constancy with which micro-organisms (micrococci) have been found in the pus, it is now generally believed to depend, chiefly or in part, in some way on their presence in the system. *Pathology.*—The disease appears to begin generally, as here described, as an acute infective inflammation of the periosteum which rapidly spreads through the bone to the medulla; but some believe that it begins in the medulla, and thence spreads to the periosteum. In any case pus is rapidly formed beneath the periosteum, stripping the latter from the bone, which thus cut off from its nutrient supply dies. Sometimes the whole diaphysis may thus perish. The epiphyses, however, generally escape, as they are supplied by a separate set of vessels, which, as long as the epiphysial cartilage remains unossified, do not anastomose with those of the diaphysis. For the like reason the joints usually escape, but as the periosteum is continuous with their capsular ligament the inflammation may at times spread to them through this structure.

Symptoms and diagnosis.—The disease is attended with severe inflammatory fever, and is often preceded by a rigor, and sometimes accompanied by delirium. The shafts of the long bones are most frequently attacked, especially the lower end of the femur, the tibia, and the humerus. The nature of the local mischief may not at first be recognised and the affection may be mistaken for acute rheumatism, but the deep-seated intense pain which becomes agonizing on the least attempt at handling soon makes it probable that the periosteum is affected. The soft parts covering the bone become swollen and œdematous, the skin white and waxy looking, and later dusky red, clearly indicating the presence of deap-seated suppuration. From abscess, however, it cannot always be diagnosed, except by an exploratory incision which will disclose bare bone. Should the joint become involved the symptoms become more urgent and the local signs of acute arthritis supervene. Signs of blood poisoning now frequently manifest themselves, and the patient may rapidly succumb to septicæmia or pyæmia. Should recovery take place it is usually with the loss of considerable portions of bone, and after months of suffering, or it may be with a stiff joint or the loss of a limb.

Treament.—Immediately the nature of the disease is discovered a free incision should be made to the bone under the strictest antiseptic precautions, and the wound dusted with iodoform and dressed with iodoform gauze or similar antiseptic material. Abundant fluid nourishment, and probably stimulants, will be required with large doses of quinine if symptoms of blood-poisoning supervene. Should a joint become involved and suppurate it must be laid freely open and dressed antiseptically; whilst if the wound leading to the dead bone becomes septic, and signs of sapræmia occur, the question of amputation must be raised. The necessity of an early incision cannot be too strongly insisted upon, as by its means extensive denudation of the bone and necrosis may frequently be averted, and the risks of blood-poisoning greatly reduced. Should necrosis occur, the dead bone will have to be removed when it has become loose. Sub-periosteal resection of the whole of a diaphysis is recommended by some surgeons as a means of preventing or lessening the danger of blood-poisoning, but the results hitherto obtained do not appear to have been very favourable.

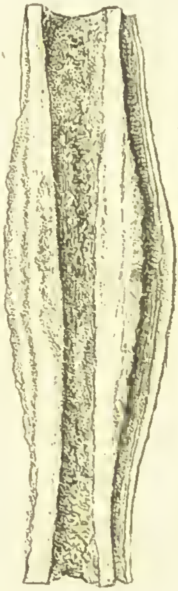


Fig. 42.—Chronic periostitis. (From St. Bartholomew's Hospital Museum.)

Chronic periostitis is nearly always associated with some amount of inflammation of the subjacent bone, and is generally limited in extent, constituting what is commonly called a *node*. *Cause.*—It is mostly due to syphilis, but may be of rheumatic, tuberculous, strumous, or traumatic origin, or caused by the spread of inflammation from an ulcer of the soft parts. It sometimes occurs as a sequela of typhoid and other of the continued fevers. *Pathology.*—The periosteum becomes swollen and thickened from small-cell-infiltration of its deeper layers, whilst a similar infiltration occurs in the Haversian canals of the contiguous bone. The inflammatory material may, under appropriate treatment, be absorbed; or it may undergo ossification, or more rarely break down into pus leading to caries or sometimes to necrosis of the subjacent bone. The ossifying variety (see Fig. 42), or the hard node as it is called when circumscribed in extent, is more common in the long bones, the suppurating in the bones of the cranium. A suppurating node in the extremities is probably always of strumous origin; a suppurating node on the cranium is generally syphilitic.

Symptoms and diagnosis.—The patient commonly complains of a deep-seated, dull, boring pain, worse by night than by day. On examination a hard, irregular swelling of the bone is felt, not as a rule very painful on handling, and not accompanied by redness of the skin. On the head the swelling is soft and fluctuating, and may have to be diagnosed from an abscess, new growth, or sebaceous cyst. Its evident connection with the bone, the history of syphilis, the effect of treatment, and, if still in doubt, exploration with a grooved needle will clear up the point.

Treatment.—Iodide of potassium is useful in all forms of chronic periostitis, but it may often be necessary to give it in large doses. In the syphilitic variety it acts like a charm. In the rheumatic an ointment containing iodide of potassium, mercury, and belladonna may also be used locally with benefit. In the strumous, cod liver oil and syrup of the iodide of iron should be given. In all forms opium internally is indicated when there is much pain. The soft node on the cranium should on no account be opened, even where the skin is inflamed and appears about to give way, as iodide of potassium will then often promote complete resolution.

OSTEO-MYELITIS or inflammation beginning in or chiefly affecting the medullary membrane and cancellous tissue of bone, may like periostitis be acute or chronic.

ACUTE OSTEO-MYELITIS may also occur as a *simple localized*, or as a *diffuse septic* or *infective inflammation*.

SIMPLE ACUTE OSTEO-MYELITIS is generally the result of an injury exposing the medulla as a compound fracture, or the sawing of a bone in amputation. In the latter instance it is usually quite local, though at times it may spread some distance up the bone and cause *central necrosis*. The sequestrum in such a case has commonly a conical form, in consequence of the inflammation as it spreads up the medullary cavity affecting less and less of the surrounding bone lamellæ. Beyond keeping the wound perfectly aseptic and removing the sequestrum when loose, no special treatment is required.

DIFFUSE INFECTIVE OR SEPTIC OSTEO-MYELITIS.—*Cause.*—This variety may be idiopathic (infective) or traumatic (septic) in origin. The idiopathic variety, like acute infective periostitis, usually occurs in young and either debilitated or strumous subjects without apparent cause, and also like it is generally believed to depend upon the presence of micro-organisms (*micrococci*) in the system. Indeed, as already stated, the disease described as infective periostitis is believed by some pathologists always to begin as an infective osteo-myelitis. The traumatic variety appears only to occur as the result of injury to the interior of bone, especially where the cancellous tissue is exposed, and where the wound is not kept aseptic. Hence it is most often met with after compound fracture, excisions, amputations, and the operation of trephining the skull.

Pathology.—Whether idiopathic or traumatic the inflammation rapidly spreads through the bone to the periosteum, and diffuse suppuration ensues, the danger of sapræmia, septicæmia, and pyæmia being even greater than in diffuse periostitis in consequence of the large patulous veins of the medulla becoming filled with purulent and either infective or septic thrombi. The idiopathic form would appear to depend upon the presence of infective micro-organisms (*micrococci*) in the system; the traumatic usually on those of a septic nature (*bacteria*) introduced from without, and hence is probably preventable if the wound is kept strictly aseptic. Should the patient in either case not be carried off in a few days by sapræmia, septicæmia, or pyæmia, the whole diaphysis may die, or suppuration occur between the diaphysis and epiphyses, and destruction of the neighbouring joints ensue (Fig. 43). In less severe cases the medullary membrane may become thickened, and only the layers of bone immediately surrounding it may die (*central necrosis*).

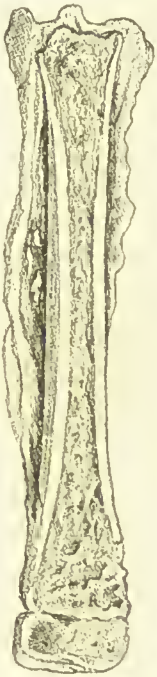


FIG. 43. — Acute osteo-myelitis of the tibia, with destruction of the knee and ankle joints. (St. Bartholomew's Hospital Museum.)

The symptoms of the idiopathic form are similar to those of acute infective periostitis (see p. 202), save that at first there may be less œdema and swelling of the soft parts; but soon the periosteum becomes involved, and then the one disease can hardly be distinguished from the other. The septic or traumatic variety is attended by high fever, rigors, and swelling and œdema of the limb, and a puffy tumour of the scalp when the diploë is involved. The wound looks unhealthy, the flaps separate, and the periosteum recedes, leaving the end of the bone exposed. A fungous mass of granulations generally protrudes from the medulla of the divided bone.

Treatment.—In the idiopathic variety an early and free incision through the periosteum to the bone should be at once made. In traumatic cases every effort should be directed towards rendering the wound aseptic, and ensuring an efficient drain. Of late, considerable success appears to have attended the scraping out of the inflamed medulla from the affected bone, and then insufflating the cavity with iodoform. The constitutional treatment should be similar to that described under *acute periostitis.* Should blood-poisoning (*sapræmia*) threaten, the question of amputation must be raised. If this is decided on it should be done through the knee-, elbow-, or shoulder-joints, if the bones of the leg, forearm, or arm are involved, so as to avoid again cutting through cancellous bone. Amputation at the hip-joint is in itself so serious an operation that it could hardly be of any avail in the case of osteomyelitis of the femur. When septicæmia or pyæmia is already fully established amputation should not be undertaken.

CHRONIC OSTEO-MYELITIS can hardly be distinguished from chronic osteitis. Indeed, in chronic inflammation of bone the soft tissues lining the medulla, cancellous spaces, and Haversian canals are generally equally involved in the process, as is also frequently the periosteum. At times, however, the inflammation may be more or less limited to the medullary membrane, and to the layers of bone contiguous to it, and may then terminate either in central necrosis, or in ossification and the consequent obliteration of the medullary cavity (*osteo-sclerosis*).

OSTEITIS, or inflammation of the bone itself, is always associated with some amount of inflammation of the periosteum and of the medullary membrane, and hence it is often difficult in any given pathological specimen to determine whether it is one primarily of osteitis, periostitis, or osteo-myelitis. It may occur in any bone, or in any part of a bone, but is most frequent in the cancellous ends of the long bones, in the cancellated bones of the tarsus and carpus, and in the bodies of the vertebræ. The term osteitis as here employed refers to a chronic or subacute inflammation of bone, acute inflammation of bone being practically indistinguishable from acute osteo-myelitis or periostitis, under which it is included.

The *causes* may be predisposing and exciting. Among the former may be mentioned syphilis, tubercle, struma, and rheumatism; among the latter any local injury, and exposure to cold damp, or malarial influences.

Pathology.—As in inflammation of soft parts, the first stage of osteitis is one of increased vascularity, the bone appearing red and injected from dilatation of the blood-vessels in the Haversian canals. Next, exudation and escape of leucocytes take place into the delicate connective tissue occupying the space between the blood-vessels and the bony walls of the Haversian canals and cancelli respectively. The earthy salts are loosened from their connection with the animal matter, and the bone lamellæ and trabeculæ are softened, eaten into as it were, and absorbed by the pressure of the inflammatory material which here, as elsewhere, assumes the form of a small-cell-exudation (*granulation-tissue*). The bone is destroyed irregularly, appearing crescentically eaten out into spaces known as *Howship's lacunæ*, in each of which, and immediately in contact with the bone, are found large cells (*osteoclasts*) containing many nuclei. It is believed that these osteoclasts, which are in some way derived from the inflammatory exudation, take an important though unknown part in the absorption of the bone. The bone-corpuscles themselves are generally thought to be entirely passive, and to take no part in the rarefying process. In this way the Haversian canals and cancelli become dilated, the compact bone being thus converted into cancellous, and the cancellous further widened out (see Fig. 44). The periosteum and medullary membrane generally appear thickened. In inflammation of bone, as in inflammation of the soft tissues, several terminations may occur. Thus, *resolution* may take place, and the bone resume more or less its normal appearance; or the inflammatory material may undergo *ossification*, and the bone become hard and indurated (*osteo-sclerosis* or *osteoplastic osteitis*), a change comparable to that which occurs in the fibroid thickening

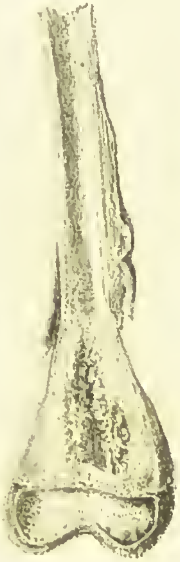


FIG. 44.—Rarefying osteitis. (St. Bartholomew's Hospital Museum.)

of the soft tissues; or the rarefying process may continue until the affected portion of bone is completely detroyed by the granulation-tissue (*rarefying osteitis* or *caries*), a termination similar to ulceration; or if the inflammation is more acute, the vessels in the Haversian canals may become strangulated by the pressure of the inflammatory material, and the inflamed portion of bone die (*necrosis*), a termination of like nature to gangrene of the soft tissues; or finally, the inflammatory material may break down into pus (*suppuration*), and an abscess be produced in a way similar to that which occurs in the soft parts.

Signs and diagnosis.—The signs vary according to the intensity of the inflammation, and are similar to those of simple periostitis, and when, as is frequently the case, the osteitis is associated with inflammation of the periosteum the two can hardly be distinguished. There is deep-seated boring pain, worse at night and increased on exercise, perhaps some slight œdema, but seldom any redness unless the periosteum is involved, and then only when the bone is superficial. There is at first no swelling of the bone, though subsequently it may become perceptibly enlarged. The deep-seated character of the pain, its increase and long continuance after percussion of the bone, with possible relief by steady pressure, and the absence of much, if of any, perceptible swelling, point to osteitis; whereas pain of a more superficial character and increased on pressure, together with an earlier appearance of swelling, indicates periostitis. From chronic abscess it is not always possible to diagnose osteitis, though in abscess the pain is generally more localized, and a slight yielding of the bone at one spot may be discovered.

Treatment.—Rest, elevation of the part, a few leeches in the more acute forms, the administration of iodide of potassium and in some instances mercury, the application of small blisters from time to time in the more chronic cases, and opiates internally with opiate or belladonna liniments externally to relieve pain. In obstinate cases linear osteotomy, which consists in making an incision down to the inflamed bone, and continuing it into the bone substance by means of a Hey's saw or a chisel, will, by removing tension, generally give permanent relief and prevent further changes ensuing. Should the existence of an abscess be suspected the bone may be drilled in several directions or a small trephine applied. Where there is a taint of gout, struma or rheumatism, appropriate remedies for these affections must, of course, be given.

RAREFYING OSTEITIS, CARIES, OR ULCERATION OF BONE, is comparable to ulceration of the soft tissues, and is characterized by the rarefaction, molecular death, and loss of substance of the bone-tissue, and the tendency of the

thinning of bone

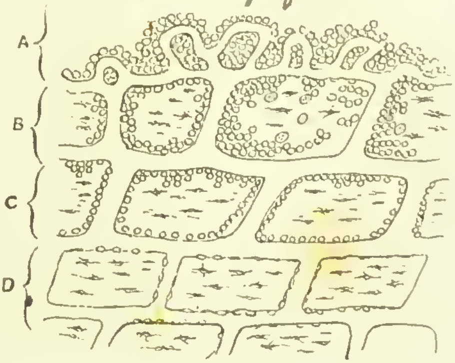


FIG. 45.—Diagram of caries. A. Granulation-tissue; B. Small-cell-exudation destroying the bone; C. Small-cell-exudation between vessels and walls of the Haversian canals; D. Normal bone.

inflammatory exudation to caseous degeneration and suppuration.

Cause.—Tubercle, struma and syphilis are undoubtedly the most frequent causes of caries. Sometimes, however, caries would appear to depend on a debilitated state of the system, in which there is no evidence of tubercle or syphilis, and to which the term struma can hardly with propriety be applied. Occasionally it is the result of an injury.

Pathology.—Caries, as has already been stated, is one of the terminations of osteitis; indeed, it is often somewhat difficult to say where osteitis ends and caries begins. In caries the thinned and eroded trabeculæ of the inflamed bone become still further thinned and eroded by the action of the small-cell-exudation and osteoclasts until the affected portion of the bone is completely destroyed and replaced by granulation-tissue. Under appropriate treatment ossification of the granulation-tissue may occur; more often, however, especially in tuberculous cases, the inflammatory material undergoes caseation, and may break down into pus and an abscess be formed, which may remain as such in the interior of the bone or under the periosteum, or later may open externally, giving rise to a sinus leading to the disease. In other cases the small-cell-exudation undergoes further proliferation, and either makes its way to the surface of the bone (Fig. 45), and thence through the soft tissues and skin, or it perforates the articular cartilage and enters a joint (*fungating caries*). At other times the granulation-tissue merely destroys the bone without the production of pus (*dry caries* or *caries sicca*); whilst again the inflamed bone in the centre of the area may die *en masse* from the cutting-off of its blood-supply, and become separated from the surrounding bone, forming a sequestrum at the centre of the carious spot (*caries necrotica*). In tuberculous cases giant-cells and the tubercle bacillus have been discovered in the inflammatory exudation. The favourite seat of caries is in the cancellous tissue, whereas that of necrosis is in the compact. It is most frequently met with in the bodies of the vertebræ, in the cancellous ends of the long bones, and in the short bones of the tarsus and carpus. The tubercular and the strumous varieties, to which many restrict the term caries, are distinguished by the more marked tendency of the inflammatory material to undergo caseous changes; by the soft, greasy and crumbling condition of tho bone; by the more extensive destruction of the bone; and by the little tendency shown towards the formation of new bone and repair.

The *symptoms* at first are those of local chronic osteitis and periostitis, namely, some pain, with œdema and swelling of the soft parts over the inflamed bone; but soon the inflammatory products make their way to the surface, and a sinus or sinuses leading to the carious bone form. The sinuses have generally a button of œdematous granulations at their entrance, and a thin, purulent, and commonly foul-smelling discharge containing bone salts in solution escapes from them. On probing or on enlarging the sinus and introducing the finger, the bone is felt to be soft and friable, breaking down and readily bleeding. Caries of the vertebræ and of the articular ends of bone will be described under Diseases of the Spine and Joints respectively.

The *treatment* will necessarily vary according to the situation of the disease. When accessible the carious bone may be gouged away. In doing this it will be known when all the carious bone is removed by the part becoming hard to the gouge. Unfortunately, however, after the carious part has been removed the disease may recur in the surrounding bone, so that in caries of the tarsus or carpus it may be better to excise the whole of the affected bone, or where the caries is extensive, to amputate the foot or hand.

NECROSIS is the death *en masse* of the whole or part of a bone, and is analogous to gangrene of soft parts. It is, however, of more frequent occurrence than gangrene, inasmuch as, owing to the hard and resisting nature of bone, the vessels are more liable to become compressed by the inflammatory effusion, and the blood-supply in consequence to be cut off. For the same reason necrosis is more common in compact than in cancellous bone; whilst the reverse holds good with regard to caries. Hence, moreover, necrosis is more frequent when the inflammation is acute, caries when it is less acute, as in the latter case the bone-trabeculæ slowly yield, and disintegrate before the less quickly-produced inflammatory exudation, and the vessels consequently escape compression. The bones most often affected are the tibia, the femur, the lower jaw, the bones of the skull, and the phalanges of the fingers.

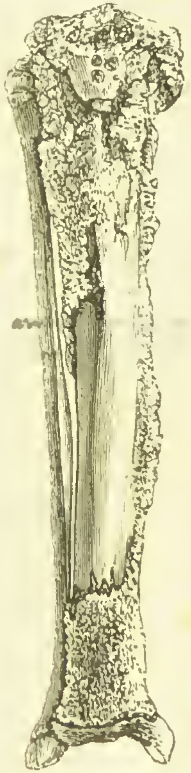


FIG. 46. — Necrosis of shaft of tibia. (Druitt's Surgery.)

Cause.—The immediate cause of necrosis, like gangrene, can in all cases be traced to the cutting off of the blood-supply of the bone, and this again may be due to inflammation, injury, or more rarely, as in the necrosis which sometimes occurs in old people, to some change in the vessels probably analogous to that producing senile gangrene of soft parts. The causes of inflammation of bone may, therefore, also be looked upon as causes of necrosis; but syphilis, the specific fevers, especially scarlatina, and mercurial and phosphorus poisoning, may be particularly mentioned.

Pathology.—In injury, the death of the bone is due to the stripping off of the periosteum, the destruction of the medullary membrane, or more rarely the plugging of the vessels in the Haversian canals with clots. In this way necrosis may occur after compound fracture, or in stumps after amputation; but the inflammation that follows the injury has no doubt also a share in its production. The way in which necrosis is brought about in inflammation has already been described under periostitis, osteitis, and osteo-myelitis, and according as it results from one or other of these causes will it vary in its situation and extent. Thus, when due to simple periostitis it is generally limited to the external lamellæ of the bone (*peripheral necrosis*); when to simple osteo-myelitis to the layers immediately surrounding the medullary canal (*central necrosis*); when to diffuse, septic or infective periostitis or osteo-myelitis it may affect the whole thickness of the shaft (Fig. 46), and possibly the whole diaphysis

ecrosis

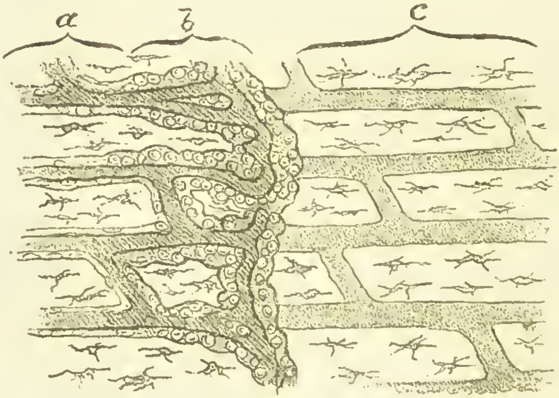


Fig. 47.—Diagram of the process of separation of dead bone. *c*. Dead bone; *b*. Inflamed living bone with formation of granulation-tissue where it is in contact with the dead part; *a*. Healthy living bone.

(*total necrosis*); whilst when due to osteitis it is usually associated with caries and only a portion of cancellous tissue perishes (*caries necrotica*).

Characters of dead bone.—The dead bone, which is called a sequestrum or an exfoliation, is bloodless, white, hard, dry and sonorous when struck, but often becomes brown or black when exposed to the air and the action of the discharges. Its free surface is smooth and even, or if previously inflamed, rough and irregular; its margins are serrated and ragged; and its previously attached surface is rough and uneven. It is heavy when sclerotic changes have occurred, light and porous when associated with caries. *Process of separation.*—When a portion of bone has become necrosed it acts as a foreign body and nature tries to cast it off. In some situations she is successful, in others she fails, and if not assisted by art the dead bone may remain as a lifelong source of irritation. The separation of dead bone is best studied in superficial situations, as in the cranial bones (Fig. 48), where its process can be watched. Here, say, from the breaking down of a syphilitic node (*syphilitic periostitis*), a portion of bone is exposed and dies. This acting as an irritant causes the bone around to become inflamed (Fig. 47); rarefaction (*ulceration*) ensues, and around the dead portion is formed a groove, which gradually deepens and extends beneath the dead part until the latter is completely cut off from the living, and if not removed by art simply comes away, or *exfoliates* as it is technically termed. The cavity left becomes filled up with granulations, which

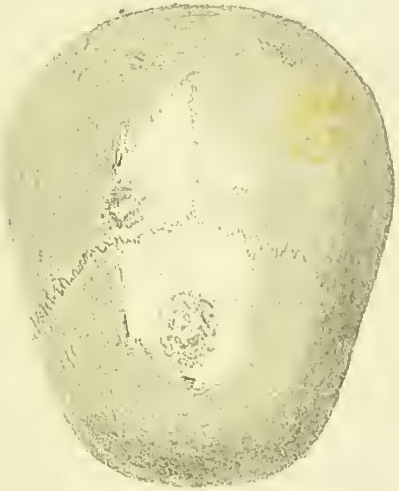


Fig. 48.—Syphilitic necrosis of the skull. (St. Bartholomew's Hospital Museum.)

subsequently ossify, and so restore the lost part. In situations, as in the tibia (Fig. 49), where the periosteum has not been destroyed, ossification of this membrane proceeds at the same time as the bone is being separated. The dead bone thus becomes surrounded on all sides by bone, and lies bathed in pus in a cavity lined with granulations (Fig. 50), and though loose, is thus prevented from being cast off. It is then said to be *invaginated*, and is called a *sequestrum*. At certain spots where the periosteum and soft tissues have been perforated by the discharges from the inflamed bone making their way to the surface, ossification does not occur, and these apertures thus left in the casing of new bone are called *cloacæ* (Figs. 49, 50, 51, *d*). After the removal of the sequestrum the cavity (Fig. 51, *f*) fills up with granulations, though more slowly than after the removal of an exfoliation.

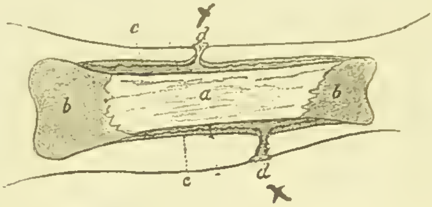


FIG. 49.

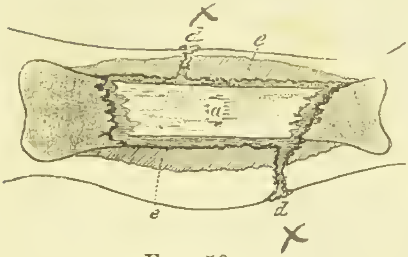


FIG. 50.

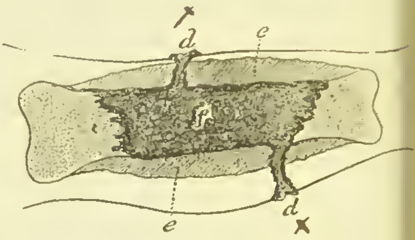


FIG. 51.

FIGS. 49, 50 and 51 illustrate the formation of a sequestrum, its separation from the living bone, and the cavity left after its removal. *a*. Dead bone ; *b*. Living bone ; *c*. The separated periosteum lined by granulations ; *d*. Cloacæ lined by granulations, which are indicated by shading, and are continuous with those lining the cavity containing the sequestrum ; *e*. New periosteal bone perforated by cloacæ. *f*. Cavity left after removal of dead bone. (After Billroth.)

Symptoms.—These vary according to the cause, stage and situation of the necrosis. When of inflammatory origin the symptoms at first will be those, already described, of periostitis, osteo-myelitis or osteitis, according as one or other of these has produced it. When suppuration has occurred and an incision has been made to the dead bone, or the discharges have made their way to the surface, or the wound, in the case of an injury, leading to the dead bone has remained open, a sinus or sinuses will exist. These generally discharge a thick foul-smelling pus, and are accompanied by much thickening of the bone, and redness and brawniness in some instances of the surrounding skin. On passing a probe the dead bone will probably be felt. In traumatic cases there will further be the history of the injury. Having discovered dead bone you should next ascertain if it is loose. This may be done by observing if it can be moved by the probe, or, if two sinuses exist, by passing a probe down each and pressing alternately first in one, then in the other. If the sequestrum is loose, a see-saw movement may thus be given to it. In superficial situations such as the cranium, or where a bone protrudes or is exposed, as in a stump or compound fracture, the dead bone will at once be known by the characters already given (page 212). *The chief distinctive signs between necrosis and caries* are:—In necrosis the dead bone is generally hard and smooth, in caries soft, rough, and crumbling; in necrosis the granulations round the sinus are healthy and the skin is generally normal, in caries there may be no granulations, or if present they may be œdematous, and the skin around is undermined or inflamed; in necrosis the discharge is thick and yellow, in caries thin and watery; in necrosis there may be great thickening of the bone, in caries there is usually but little. Do not forget, however, that caries may be associated with necrosis. In some cases of necrosis no suppuration occurs (*quiet necrosis*), but the bone becomes greatly swelled, resembling a new growth, from which it may be impossible in some instances to distinguish it without an exploratory incision (see Tumours of Bone).

Treatment.—The dead bone should be removed as soon as it is loose. When it is superficial this can generally be done by the forceps, after slightly enlarging if necessary the sinus through the soft tissues, or where the end of the sequestrum is exposed in a stump by simply drawing it out. But where the dead bone is invaginated and the cloacæ leading to it are small a more serious operation is required (*sequestrotomy*). The operation is much facilitated by the use of an Esmarch's bandage. The sinus leading to the most convenient cloaca should be enlarged by a simple incision in the longitudinal axis of the limb, the sequestrum seized by forceps, and if practicable drawn out. If the cloaca is too small to admit of this it must be enlarged, or two cloacæ, if present, may be laid into one by cutting away with a mallet and chisel, Hey's saw, gouge, &c., the intervening portion of the sheath of new bone. No more of the new bone, however, than is absolutely necessary should be cut away for fear of weakening the limb. For the same reason cloacæ should be enlarged in the longitudinal axis of the bone. The extraction of the sequestrum may often be aided by the use of the elevator, or by cutting it in two pieces with the bone-scissors. The cavity should then be sprinkled with iodoform, packed with iodoform gauze to prevent bleeding, and the wound dressed with gauze impregnated with the same or other antiseptic material. Whilst the cavity is healing, which when large it may take many weeks or even months to do, the patient's strength must be supported by tonics and a generous diet. At times the sequestrum is so intimately interlocked between the old and the new bone that it may be impossible to remove it. In such cases, where the patient's powers are flagging from the long-continued suppuration, or signs of lardaceous or other visceral disease are manifesting themselves, amputation may be called for.

SUPPURATION AND ABSCESS IN BONE.—Diffuse suppuration in bone has already been described as a common termination of diffuse osteo-myelitis and periostitis. Circumscribed suppuration or abscess is generally of the chronic variety, and, as already stated, is one of the terminations of chronic osteitis.

Chronic abscess in bone is most common in the cancellous ends of the long bones, especially the upper and lower end of the tibia and lower end of the femur, but is occasionally met with in other bones.

The *causes* especially leading to the termination of osteitis in abscess are thought to be the presence of tubercle or of micro-organisms, the strumous diathesis, or a feeble state of health. At times the abscess can be apparently traced to an injury.

Pathology.—In the course of rarefying osteitis the bone-trabeculæ are gradually destroyed, and their place is taken by a small-cell-exudation, which now assumes the form of granulation-tissue. This in the focus of the inflamed spot softens and breaks down into pus, whilst that around the centrally-softened spot constitutes the abscess-wall, and forms to the naked eye a distinct membrane (Fig. 52) lining the bony cavity (*pyogenic membrane*). The bone around the abscess generally becomes sclerosed owing to the ossification of the inflammatory products, whilst new bone is formed beneath the periosteum. In this way as the abscess enlarges at the expense of the old bone, new bone is continually formed around, and hence the pus seldom makes its way to the surface as in the soft parts. As the abscess, however, approaches a joint new bone is not formed beneath the articular cartilage, and so the pus on reaching the cartilage may perforate it and escape into the joint. When the inflammation is more acute suppuration may occur before the bone-trabeculæ have been completely destroyed, under which circumstance a sequestrum of cancellous tissue may be found free in the abscess cavity (Fig. 53).

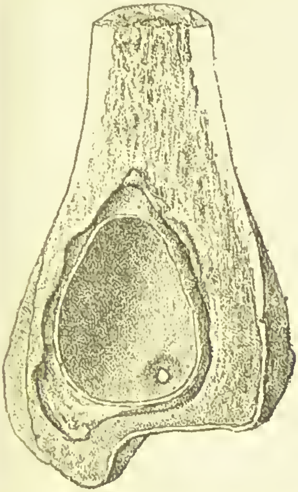


FIG. 52.—Abscess in end of tibia. (From St Bartholomew's Hospital Museum.)

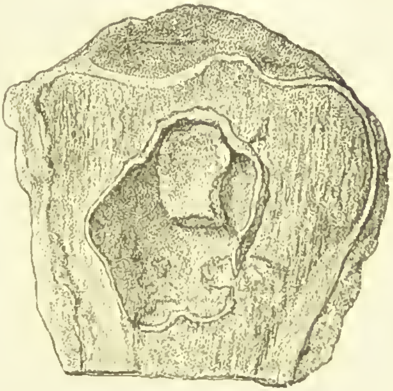


FIG. 53. — Necrosed cancellous bone in abscess cavity. (From St. Bartholomew's Hospital Museum.)

The *symptoms* are of a chronic nature, and are often obscure. Generally there is pain of a dull, boring, and localized character, often intermittent, and worse at night; tenderness on pressure at the spot where the abscess is approaching the surface; some œdema and pitting of the soft tissues; occasional enlargement of the end of the bone; and later some dusky redness of the skin. Intermittent attacks of inflammation of the neighbouring joint without other apparent cause are very suggestive of abscess. These symptoms will usually serve to diagnose abscess from rheumatism, local periostitis, and a new growth in the end of the bone. From chronic osteitis it cannot always be distinguished; but this is not of so much importance as the treatment is practically the same.

Treatment.—An Esmarch's bandage having been applied, a crucial or T-shaped incision should be made over the tender spot, and the bone trephined. If pus does not escape a perforator should be thrust in various directions into the cancellous tissue in the hope of discovering it. The abscess-cavity, after having been well scraped, should be mopped out with carbolic acid or chloride of zinc, and dusted with iodoform and the wound dressed with iodoform or other antiseptic gauze, great care being taken to keep it aseptic. Should the abscess break into the joint amputation will probably be necessary.

2. *Diseases depending upon Simple Defect or Increase in Nutrition of Bone.*

Under this head are included two diseases of bone in which neither inflammation nor such constitutional affections as syphilis or struma appear to take a part—Atrophy and Hypertrophy.

Atrophy of bone is a common accompaniment of old age. It may also be produced by pressure and disuse. Thus it is seen in the bodies of the vertebræ from the pressure of an aneurism of the aorta or a tumour in the mediastinum; in the bones of a limb from disuse, as in long-continued joint-disease, and in stumps after amputation. An atrophied bone is always decreased in weight, often in size; and in some situations, as the neck of the femur, is liable to fracture on slight provocation. Atrophy is always attended with more or less fatty degeneration.

Hypertrophy of bone is an overgrowth of bone which is due merely to an increase of nutrition and not to any inflammatory change. It is generally dependent upon excessive functional activity of the part, the bone increasing in size and strength commensurately with the hypertrophy of the muscles. It may also occur in association with general hypertrophy of the tissues in the affection known as congenital hypertrophy. It must be distinguished from inflammatory thickening of bone, a condition to which the term hypertrophy is sometimes though incorrectly applied.

3. *Constitutional Affections of Bone.*

Under this head are included Syphilitic, Strumous, and Tubercular affections of bone, Rickets and Mollities Ossium.

SYPHILITIC AFFECTIONS OF BONE are common both in acquired and congenital syphilis. In the former they generally occur during the tertiary stages of the affection, either as gummatous inflammations of the periosteum (nodes), or as chronic inflammatory thickenings or gummatous infiltrations of the bone itself, leading to caries, necrosis, or sclerosis. For a full account of the peculiarities in the above affections when due to syphilis the student is referred to a work on Pathology. The affections of the bones in *congenital syphilis* have already been briefly referred to in the section on that subject (see page 58).

STRUMA AND TUBERCLE.—We have already seen that many of the inflammatory diseases of bone, especially some forms of rarefying osteitis or caries, are attributed to the strumous diathesis, or to the presence and degeneration of miliary tubercles; and it has been pointed out in what respects the affections of strumous or of tubercular origin differ from those of a simple or traumatic nature. Here it need only be added that miliary tubercles may often be found scattered through the medulla and in the cancellous tissue in cases of acute tuberculosis; but as in these cases the bone-affection plays but a secondary part and cannot be diagnosed during life, nor indeed as a rule gives rise to any symptoms, it need not be further described.

RICKETS, though generally described under Diseases of Bone, is a constitutional affection occurring in infancy and early childhood. It is characterized by impaired nutrition and arrest of development of the whole body, and especially by the softening and the resulting deformity of the bones.

Causes.—Malnutrition produced by improper food, especially an excess of the starchy elements during infancy; debility of the mother during gestation and lactation as the result of excessive child-bearing, over-suckling, and bad hygiene, *i.e.* want of fresh air and sunshine, residence in damp dwellings, uncleanliness, and lack of attention generally. Struma and syphilis in the parent, but I think without sufficient evidence, are also given by some as causes.

Pathology.—The bone-changes consist essentially in the formation of soft, vascular, imperfectly-ossified bone, which replaces the healthy bone as the latter is gradually absorbed in the normal process of development. This ill-formed bone is produced both at the line of the epiphysis and under the periosteum, *i.e.*, in those situations where active growth normally occurs. In the former situation the intermediate semi-transparent bluish zone of ossifying cartilage between the diaphysis and epiphysis is greatly increased in thickness, and its line of junction with the bone is no longer straight but broken, in consequence of the irregular advance of ossification. The adjacent bone is soft and spongy, and contains here and there islets of cartilage which have escaped ossification, whilst its medulla is abnormally vascular. It is to the excessive formation of this proliferating layer of cartilage and ill-formed bone immediately underlying it that the enlargement of the ends of the long bones and the beading of the ribs so characteristic of rickets is due. Microscopically the cartilage-cells in the bluish zone are seen enlarged, and instead of being arranged in regular columns are grouped irregularly; whilst the calcification of the matrix between them is also seen proceeding in an irregular manner, so that calcified or ossified patches exist here and there where all should be cartilage, and portions of cartilage where all should be bone. The vascular medullary spaces which are continuous with these chan-

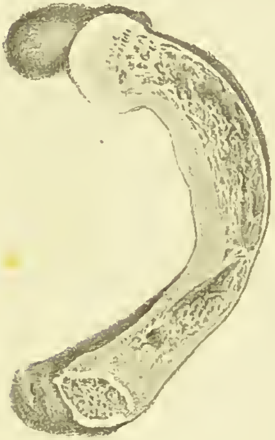


Fig. 54.—A longitudinal section of a rickety femur. (St. Bartholomew's Hospital Museum.)

nels in the shaft likewise project in an irregular manner into the cartilage, and the laminæ of bone formed from the osteoblasts lining these spaces are deficient in earthy salts. Under the periosteum, the superficial layers of which are unaffected, similar soft bone is laid down in consequence of the osteoblastic layer, though increased in thickness, producing osteogenetic fibres deficient in earthy salts. Hence, whilst all the bones are more or less softened, the long bones become swollen at their ends, and the flat bones thickened especially along their line of suture. The liver, spleen and lymphatic glands are often enlarged from irregular increase of their fibrous elements, and the muscles are generally soft, flabby and wasted.

Symptoms.—Rickets is most frequently met with between the ages of eighteen months and two and a half years. Among the early symptoms may be noticed sweating of the forehead and perhaps of the upper part of the body, throwing off of the bedclothes from a desire of the child to be cool, a general restlessness, and often an excessive tenderness on handling and aversion to movement. Sometimes large quantities of phosphate of lime are found in the urine. The abdomen is generally enlarged, and there is frequently some gastric catarrh and flatulence. The swelling of the ends of the long bones, especially of the lower end of the radius and tibia, the beading of the ribs where they join the cartilages, and the thickening of the cranial bones along their line of suture are characteristic of the disease. Later, bending of the bones occurs. Thus, the long bones generally give in the direction of their normal curves and near the epiphyses, leading to knock-knee, bow-legs, and other deformities. The yielding of the ribs to atmospheric pressure produces the deformity known as pigeon-breast. The spine presents a general curvature with the convexity backwards in infants and young children, and in older children a lateral or a lordotic curve. The pelvis generally assumes a triangular or hour-glass shape in consequence of the depression of the promontory of the sacrum. The head is square, the forehead prominent, and the fontanelles are late in closing. The occipital bone is sometimes thinned so that it yields on pressure or it may be in places absorbed, a condition known as *craniotabes*. By some pathologists, however, this condition is believed to be due to congenital syphilis. Dentition is generally delayed, or the teeth, if

Law of Bone [illegible] Structures [illegible] Cranial

cut, often soon decay and fall out. Bronchitis, diarrhœa, convulsions, laryngismus stridulus and chronic hydrocephalus are not infrequent complications; and to any of these, but especially to the first two, the child may succumb. Under appropriate treatment the disease is nearly always arrested, and perfect recovery results. The bones, however, if much bent are liable to become consolidated in their deformed condition and premature synostosis of the diaphysis and epiphysis is apt to occur inducing a stunted growth. The bones are also harder and denser than natural, especially on the side of their concavity, where a thick buttress-like layer of dense hard bone is formed, see Fig. 54.

The *treatment* resolves itself into proper feeding and correcting bad hygienic conditions. The child should have plenty of new milk and cream; and the juice of underdone meat, or underdone meat that has been pounded up, should be given in quantities suited to the age and powers of assimilation. Farinaceous food should be restricted in amount, and in the case of infants forbidden. Abundance of fresh air and sunlight and attention to cleanliness are especially indicated. In the way of medicine cod-liver oil is the most important, and may almost be looked upon as a specific. It should be combined with syrup of the phosphate or lacto-phosphate of iron and lime in half-drachm to drachm doses. The deformity of the legs may be corrected in the earlier stages by insisting upon the child not being allowed to stand or walk. To ensure it being kept off its legs splints reaching from the waist to below the feet may be applied. Confirmed deformities can only be dealt with by instruments or operation, which will be described under bow-legs, knock-knee, osteotomy, &c.

MOLLITIES OSSIUM or OSTEO-MALACIA is a rare disease characterized by softening of the bones through the reabsorption of their earthy salts and destruction of their osseous lamellæ.

Cause.—It is a disease of adult life, and most often occurs in females during the child-bearing period. Sometimes it appears to be hereditary; but its causation is practically unknown.

Pathology.—The disease appears to begin in the medullary tissue of bone which is replaced by a soft, dark-red gelatinous material somewhat resembling spleen-pulp,

Synostosis the premature & abnormal [illegible] of the cranial sutures, causes depression & irregularities of the skull.

whilst later the whole bone, with the exception of a thin layer immediately beneath the periosteum, becomes replaced by this material and reduced to little more than a mere shell. The bone appears first to become decalcified and then destroyed. The exact pathology of the process is not known, but it has been suggested that the decalcification of the bone is due to the action of lactic acid, which has been found both in the bone and the urine, or to excess of carbonic acid in the veins of the medulla, which are said in the early stages to be enlarged. The microscopical appearances lend some support to this view, as in a bone-trabecula (see Fig. 55) the decalcification is seen to begin around the Haversian canals and medullary spaces, the bone-corpuscles in these parts having entirely disappeared while in the centre of the trabecula they are still present. At times the gelatinous material is in places yellow and fatty-looking. In some of the specimens in St. Bartholomew's Hospital the medulla appears entirely filled with fatty material, but it is a question whether these specimens, though called mollities ossium, are not of a different nature from the disease to which the term is generally applied, and do not rather depend upon a senile change.

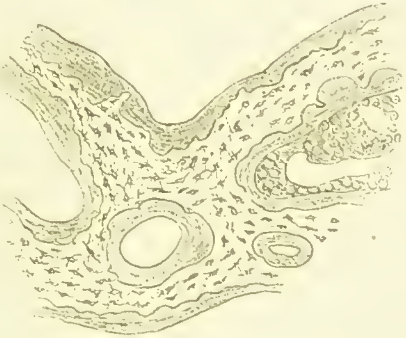


FIG. 55.—Microscopical appearance of a fragment of bone in mollities ossium.

(From Rindfleisch.)

Symptoms.—In the early stages the disease may be mistaken for rheumatism or neuralgia, as, beyond some general feeling of weakness with obscure pains in the bones, it is attended with no definite symptom. Suddenly, however, fracture of somo bone occurs, whilst others become bent and variously distorted without any or but the slightest provocation. Thus the pelvis, thorax, spine, and extremities become misshapen and sometimes extraordinarily deformed. The pelvis is flattened from side to side, the symphysis pubis projects in the form of a beak giving a rostrated appearance to the pelvic inlet, whilst the tuberosities are approximated and the pubic arch is diminished in width. Thus, parturition is rendered difficult if not impossible. The condition of the urine is an important element in the diagnosis, a peculiar form of albumen and abnormal quantities of phosphates and lactic acid being found in it. The disease progresses and the patient generally dies of exhaustion, or during parturition, or of dyspnœa consequent upon respiratory trouble induced by the weakened ribs. In a few cases recovery has taken place.

Treatment.—No remedy is at present known for the disease. The strength must be supported by tonics and abundance of nourishing food, pain must be relieved by opium, and rest enjoined in order to prevent fracture. The patient should be warned of the danger of child-bearing. Should she be already pregnant, the question of inducing premature labour must be raised; whilst, should she be at her full time, craniotomy, or in advanced deformity of the pelvis, Cæsarian section, may be necessary.

4. *New Growths in Bone.*

NEW GROWTHS.—Nearly all the varieties of tumour described in the section on that subject (p. 60) occur in bone. Some, indeed, as the exostoses, are altogether confined to the bony tissue; others occur in it so frequently that it may be said to be their favourite seat; others, again, are in this situation so rare that they may be dismissed as pathological curiosities. Some, moreover, the carcinomata, only occur in bone as secondary growths, the primary malignant tumours of bone, formerly described as carcinomata, being now classed as sarcomata. Tumours of bone may spring from the periosteum, the medulla, or the bone itself, and exhibit a remarkable tendency to undergo calcification or ossification, and when of slow growth to assume the character of true bone.

OSTEOMATA OR OSSEOUS TUMOURS have the structure of true bone, and are only met with in connection with bone. They must be distinguished from other forms of tumour that have undergone calcification or ossification. They may be divided into the circumscribed and the diffuse.

Circumscribed osseous tumours or exostoses occur in two chief forms, the cancellous and the compact.

(*a.*) *The cancellous or spongy exostoses* consist of cancellous bone containing marrow in its cancellous spaces, and surrounded by a delicate layer of compact bone, which itself is covered with a capping of cartilage, or sometimes merely with periosteum. They are most frequently met with in the young, and are considered by some to be ossifying enchondromata and to spring from portions of the epiphysial cartilage that has escaped ossification. Their common situation is at the junction of the diaphysis and epiphysis of long bones, or at the origin or insertion of muscles—as for example, the insertion of the adductor magnus into the tubercle just above the internal condyle of the femur, and the pectoralis major into the external bicipital ridge of the humerus. They are also very common on the last phalanx of the great toe.

(*b.*) *The compact or ivory exostoses* consist of dense, hard, bone, which usually contains no Haversian canals. They nearly always spring from the bones of the skull and face, and are generally sessile or broadly pedunculated, and of a lenticular shape.

Symptoms.—The cancellous variety are met with as hard, smooth or irregular, and frequently pedunculated tumours of slow growth, and are commonly of small or moderate dimensions. Sometimes they are quite painless, but at other times they cause pain on movement or pressure, as is the case with the small exostosis which so frequently grows from the distal end of the dorsal surface of the last phalanx of the great toe. This, which is usually harder than the more common form of cancellous exostosis, but less hard than the ivory, occurs as a tumour projecting under the nail, and raising it up as it grows. In some cases exostoses affect simultaneously many bones, and at times nearly all the bones of the body. They are then generally hereditary, and often symmetrical, and are spoken of as *multiple exostoses.* They have the structure of the cancellous form. The evident firm attachment of the ivory exostoses of the skull to the bone, their slow growth, small size, great hardness, the freedom with which the scalp moves over them and the absence of pain and history of fracture or other injury, sufficiently serve to distinguish them.

Treatment. — A spongy exostosis, unless occasioning pain, deformity, or other inconvenience, or growing rapidly, may be left alone; otherwise, it should be removed by a chisel, bone-nippers, saw, &c., taking care it is completely extirpated, as what is left will have a tendency to grow again. In removing an exostosis from near the knee-joint, the synovial membrane may be avoided by flexing the knee, and so drawing the membrane away. Ivory exostoses should not as a rule be interfered with, as they are so hard that no ordinary saw will cut through them, and the skull has been fractured in attempts to remove them with the chisel. If causing great inconvenience, however, it is probable that they might be safely removed by the rapidly-revolving saw of the surgical engine.

Diffuse osseous tumours occur in connection with the bones of the face, often filling up the antrum, occluding the nasal chambers, and producing much deformity. They are composed of finely-cancellated bone, and are more compact than the cancellous exostoses, but less compact than the ivory. Their slow growth, extreme and uniform hardness, and irregular nodulated surface will serve to distinguish them from sarcomata undergoing ossification. There is usually little or nothing that can be done in the way of treatment. The superior maxillary bone, however, has at times been removed when the growth has been confined to it alone.

Enchondromata or cartilaginous tumours.—The general and microscopical characters of these growths have already been described under Tumours (p. 66). In the bones they are most frequently met with in the fingers (Fig. 56) and the ends of the long bones. In the fingers, where they are generally multiple and often congenital, they usually begin in the interior of the ends of the phalanges or metacarpal bones, and as they increase in size, expand the bone around them into a thin shell, which may finally give way, allowing them to protrude. When growing from the articular ends of long bones, they generally spring from the periosteum, and thence grow both outwards and inwards, but seldom involve the articular surface. They are thought by some to possibly arise from the epiphysial cartilage, especially as they are most often met with in the young. They should not be confounded with sarcomata, in which considerable masses of cartilage are frequently developed, or with the exostoses, which are often capped with cartilage, and are regarded by some as ossifying enchondromata. The enchondromata rarely ossify, but may undergo calcification or mucoid softening, and when unmixed with sarcomatous elements are quite innocent.

Symptoms.—Their slow growth, great hardness, evident attachment to the bone, the absence of glandular enlargement, and non-implication of the surrounding tissues and skin will serve for their diagnosis. When of large size ulceration of the integuments covering them may be produced by their pressure.

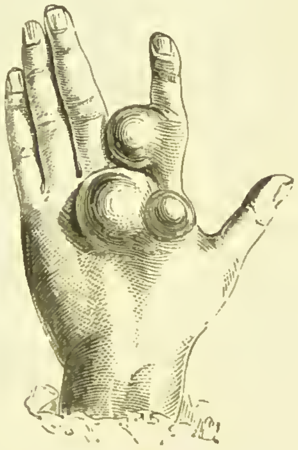


FIG. 56. — Cartilaginous tumours of the bones of the hand. (From Druitt's Surgery.)

Treatment.—If small, and involving, say, only one finger, they may be enucleated, taking care not to injure the neighbouring joint. But when several fingers are implicated, and the hand is rendered useless, amputation of the affected fingers, or of the whole hand, may be necessary. The removal of the limb is usually called for when they grow about the articular end of a long bone, especially if they have attained a large size.

FIBROMATA OR FIBROUS TUMOURS seldom occur in bone except in the jaws or in connection with the base of the skull. They then constitute the common form of epulis and naso-pharyngeal polypus respectively, and are described under Diseases of the Jaws and Nose.

LIPOMATA OR FATTY TUMOURS too rarely occur in bone to require special mention. I have seen one or two growing from the outer surface of the periosteum (*parosteal lipoma*). They were not diagnosed before operation.

SARCOMATA in bone may be divided into the periosteal and the endosteal, the former being commonly of the round-celled, spindle-celled, or mixed variety, the latter of the myeloid. The *periosteal* spring from the

Endosteal myeloid least malignant.

?Periosteal round, spindle or mixed [illegible] deeper layers of the periosteum, and as they increase in size invade the bone beneath on the one hand, and the soft tissues surrounding them on the other, till finally the skin is involved, and they protrude as a fungous mass if the patient has not been already carried off by the dissemination of the growth through internal organs. They are very prone to calcification and ossification and are then sometimes spoken of as osteoid sarcomata; but the simple expression ossifying sarcomata, as less misleading, and as more explanatory of what really happens, had better be employed. Their favourite situations are the neighbourhood of the large joints, which however they seldom involve. Though not usually implicating the lymphatic glands, they often rapidly infect the system through the blood-stream and quickly return after removal. The *endosteal* or central spring from the medulla in the interior of the bone, and are of slower growth and generally less malignant than the periosteal. As they increase in size they expand the bone around them into a thin shell (Fig. 57) which finally gives way, when they grow with greater rapidity, behaving as the periosteal. The myeloid form of the endosteal sarcoma is the least malignant, and may not return after enucleation or complete removal for several or many years, and possibly not

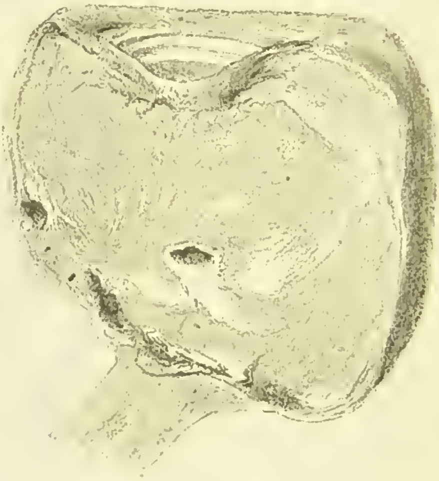


FIG. 57.—Endosteal sarcoma in head of tibia. (St. Bartholomew's Hospital Museum.)

at all. A variety called *parosteal*, in which the sarcoma involves the outer surface only of the periosteum, has been described.

Symptoms.—In a typical case of *periosteal sarcoma* there will be a rapidly growing tumour, evidently connected with the bone, not as a rule painful, nor usually attended with heat, œdema, redness, or increase of body temperature. The swelling is soft and semi-fluctuating or boggy, sometimes indistinguishable by touch from an abscess; or hard in some parts, soft in others, or, if ossifying, uniformly hard all over. The superficial veins may be tortuous and dilated, and the neighbouring lymphatic glands enlarged. The patient, who is usually young, frequently complains of having lost both weight and strength, although till later there may be no cachexia. Often there is a distinct history of the growth having appeared some time after an injury of the part, and it is probable in some cases such may be the cause of the growth. The *endosteal* are of much slower growth, and are generally accompanied by boring pain whilst the bone is being expanded. Sooner or later they give rise to a more or less uniform swelling, generally of the articular end of one of the long bones, and as the shell of bone becomes thinned a peculiar egg-shell-like crackling may sometimes be elicited on palpation. After they have protruded from the bone they present similar signs to the periosteal, and at times distinctly pulsate, especially when connected with the pelvic bones. They may then be mistaken for an aneurism.

Diagnosis.—The above signs will commonly serve to distinguish a sarcoma from an innocent tumour of bone. From an inflammatory affection, such as sub-acute periostitis or osteitis, quiet necrosis, or an abscess in the interior of the bone, it is sometimes very difficult to diagnose a sarcoma. The absence of signs of inflammation, of increased body temperature, of œdema, and of pain on pressure, point strongly to the swelling being of a sarcomatous nature. But these signs may be present in large and rapidly-growing sarcomata, and may be but faintly marked, or not apparent, in inflammatory affections. A steady increase of the growth whilst under observation, notwithstanding rest and appropriate remedies for inflammation, the gradual loss of weight and strength, and the unequal consistency and irregular surface of the swelling are more certain indications of its malignancy;

but puncture with a grooved needle, or even an exploratory incision, may be required before the nature of the tumour can be cleared up. From an aneurism, a pulsating sarcoma may be very difficult to distinguish, especially when growing from the pelvic bones. In the tumour the pulsation is not equally expansile over all parts, and although it may be stopped by pressure on the artery above, the tumour does not become smaller; nor is it felt to refill when the pressure is removed during two or three beats of the heart, as in aneurism; and a bruit, if present, is not so distinct. Portions of expanded bone, moreover, may be felt in parts of the tumour, and there may be glandular enlargement and other general signs of malignancy. From an inflammatory condition of a neighbouring joint a tumour of the end of the bone may generally be distinguished by the absence of signs of inflammation; by the swelling being less regular in contour than in a joint-affection, and apparently being connected more intimately with one of the bones entering into the articulation than the other; and by a careful review of the history of the case.

Treatment.—Periosteal growths, unless the glands are much enlarged and there is evidence of dissemination having occurred, call for amputation of the limb, or removal, if practicable, when growing from the bones of the head or trunk. Small growths, however, may at times be dissected off the shafts of the long bones, and the surface of the bone scraped, gouged away, or destroyed by the actual cautery. Endosteal growths, if small, may in some cases be enucleated, but usually like the periosteal variety, call for amputation. In some situations, as in the head of the radius, the affected portion of bone may be excised. The treatment of sarcomata of the jaws and of other special regions is described under Tumours of the Jaws, &c.

Carcinoma never occurs as a primary growth in bone. It may spread to the bone, however, from the skin or mucous membrane, as seen, for example, in some cases of squamous epithelioma of the leg or lip, or be deposited there in the course of the general dissemination following on primary carcinoma of other tissues or organs, as the breast or liver. In the latter case it is seldom discovered till after death, unless it gives rise to spontaneous fracture (Fig. 58). *Treatment.*—Where epithelioma has spread to the bone, free and early removal with the knife before the glands have become affected is the only treatment that holds out a prospect of success. In the case of a limb, amputation well above the disease is generally called for; although where the bone is but little involved a free sweep of the growth and the gouging away of the underlying bone may under some circumstances be justifiable. Glands that have become affected should be removed if practicable.

CYSTS IN BONE are rare, except in the jaws. Hydatid cysts are occasionally met with, but require no special description. The sanguineous or blood cysts formerly described were probably sarcomatous tumours in which hæmorrhage had taken place.

ANEURISMS IN BONE are occasionally met with, and vascular erectile tumours consisting of anastomosing vessels, and somewhat resembling nævi of the soft tissues, sometimes occur in the bones of the skull. The majority of pulsating tumours in bone, however, are of the nature of soft sarcomata.

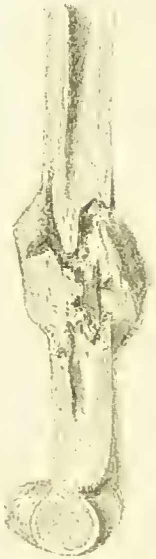


FIG. 58. — Secondary carcinoma of the shaft of the humerus causing spontaneous fracture of the bone. (St. Bartholomew's Hospital Museum.)

DISEASES OF JOINTS.

SYNOVITIS, or inflammation of the synovial membrane, may be acute, subacute, or chronic.

ACUTE SYNOVITIS.—*Cause.*—Generally a slight injury, as a sprain or over-exertion of a joint, or exposure to cold and wet in a gouty or rheumatic subject. Synovitis, moreover, especially in the knee, often occurs during an attack of gonorrhœa, and is sometimes seen in the earlier stages of syphilis. It is well known as a symptom of acute rheumatism and pyæmia, in which latter affection rapid suppuration and implication of the other tissues of the joint occur.

Pathology.—The synovial membrane becomes red and congested and loses its lustre, the synovial fringes turgid, and the synovial fluid increased in quantity and slightly turbid from admixture with inflammatory products. Resolution may now occur, or the inflammation may become chronic, or it may spread to the cartilages, bones, &c., and terminate in suppuration and the probable disorganization of the joint (see Acute Arthritis).

Signs.—The joint is hot, excessively painful, especially on movement and pressure, and, if the inflammation is very intense, the skin may be slightly reddened, and the tissues around œdematous. The joint is usually held flexed, that is, with the capsule and ligaments relaxed,—the position of greatest ease. Where the joint is superficial the swelling is well marked, the outline of the synovial membrane being distinctly mapped out. Thus in the *knee*, the joint perhaps most commonly affected, the synovial membrane can be seen extending upwards under the crureus and vasti, and bulging on either side of the ligamentum patellæ. The patella itself is raised from the condyles of the femur, and on making pressure on it the fluid is displaced, and the patella can be felt to strike against the condyles (*riding of the patella*). In the *elbow*, the synovial membrane can be seen extending under the triceps and on either side of the olecranon; in the *ankle*, bulging beneath the extensor tendons and behind the malleoli. Feverish symptoms varying in intensity according to the severity of the inflammation are generally present. The inflammation may now gradually subside or assume the chronic form. Should, however, suppuration occur, and the other tissues of the joint become involved, the pain, swelling, and œdema increase, and the skin becomes of a dusky red, whilst a chill or distinct rigor ushers in a more severe type of inflammatory fever.

Treatment.—The joint should be placed at absolute rest on a splint, and the patient, in the case of the hip, knee, or ankle, confined to bed. In applying the splint, care should be taken that the limb is in the position best suited for future use should ankylosis ensue; thus the knee should be straight, and the elbow bent at a right angle. Where the joint has already been drawn into a faulty position, this must be rectified, the patient being placed under an anæsthetic, as the manipulation is attended with intense pain. Cold, by means of evaporating lotions or Leiter's tubes, may in slighter cases be applied to the joint. When, however, the inflammation is very acute, half-a-dozen leeches followed by hot applications should be substituted for the cold, with liniments of belladonna and opium to assuage pain. Where there is much distension, and the synovial membrane threatens to give way, the joint should be aspirated and elastic pressure applied, or if suppuration occurs, laid freely open and drained antiseptically. Amputation may be called for should the patient's powers fail under the long-continued suppuration that at times ensues.

SUBACUTE SYNOVITIS.—The term subacute is applied to less severe cases of acute synovitis. But as one form of the disease differs from the other in degree rather than in kind, and as the causes, symptoms, and treatment are similar, no special description is required.

CHRONIC SYNOVITIS.—*Causes.*—Similar to those of the acute form of which it is often a sequel. When occurring in strumous subjects, it probably nearly always depends on the presence of the tubercle bacillus, and will be described under *tubercular* or *strumous disease of the joints.*

Pathology.—The synovial membrane is slightly thickened, and the synovial fluid increased in quantity; but there is little or no change in the cartilages or the other tissues, though, if the disease is neglected, it may run on to total disorganization of the joint. At times, the synovial membrane becomes greatly distended with clear serous fluid, a condition known as *hydrops articuli*, and in this state it may remain for years without any further change ensuing; or, after long periods, the synovial membrane may become thickened, and little masses of cartilage form in its hypertrophied fringes. In other instances pouch-like protrusions of the synovial membrane may extend along the muscles and other tissues, often to some distance from the joint, where they give rise to bursa-like swellings (*Morrant Baker's cysts*).

Signs.—The joint, as in the acute affection, is swollen, and the synovial membrane slightly thickened; but there is little or no heat, there may be no pain, and the skin is unaltered in appearance. The patient, however, complains that the joint feels weak and stiff on movement, but he does not suffer from starting-pains at nights. In *hydrops articuli* the synovial membrane is greatly distended but not thickened, and save a sensation of weakness and want of security in the joint on walking, the affection gives no trouble. In what may be termed the *bursal variety* of chronic synovitis, in addition to the joint-affection, more or less tense fluctuating and translucent swellings occur in the neighbourhood of the joint. On pressure, these swellings become less tense, and some of the fluid contained in them can at times be forced back into the joint.

Treatment.—The indications are (1) to prevent further irritation by placing the joint at perfect rest, (2) to promote the absorption of the inflammatory products by pressure and counter-irritation, and (3) to remove any stiffness that may remain on the subsidence of the inflammation by passive movements, shampooing, or the breaking down of fibrous adhesions. Thus, the joint should be fixed in an accurately-fitting poroplastic or a moulded leather splint, or a plaster-of-Paris bandage; and the limb, if a joint of the upper extremity is affected, should be carried in a sling. In the case of the lower extremity, the patient, if unable to lie up, may wear a Thomas's hip or

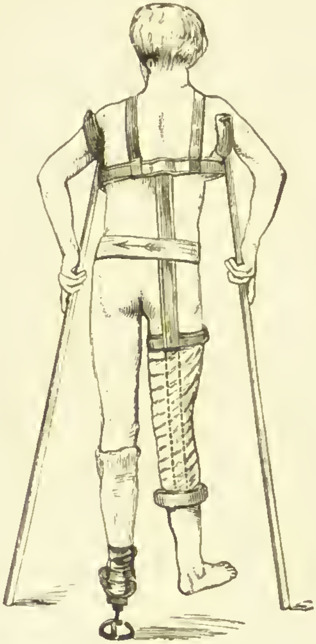


Fig. 59.—Thomas's hip-joint splint applied. Patten on sound limb. (Heath's Minor Surgery.)

knee splint, according to the joint affected, and be allowed to get about on crutches with a patten fixed to the boot of the sound limb (Figs. 59, 60 and 61). Pressure may be applied by strapping the joint with ammoniacum and mercury plaster, or with Scott's dressing, or by means of a Martin's bandage. Counter-irritation may be effected either with the liniment of iodine, small flying blisters, or the actual cautery. Rest, however, though most essential in the treatment, should not be continued too long, lest the joint become stiff. Should this happen, friction, shampooing, and passive movements must be sedulously used, or if all signs of inflammation have ceased, the adhesions may be broken down under an anæsthetic. In the meantime, the patient's general health must not be neglected, and any constitutional tendency to gout, rheumatism, &c., should be corrected by appropriate remedies.

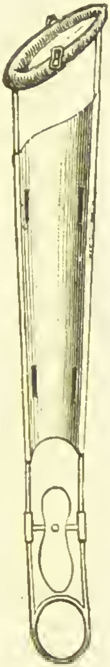


FIG. 60.—Thomas's knee-joint splint with foot-piece for extension. (Heath's Minor Surgery.)

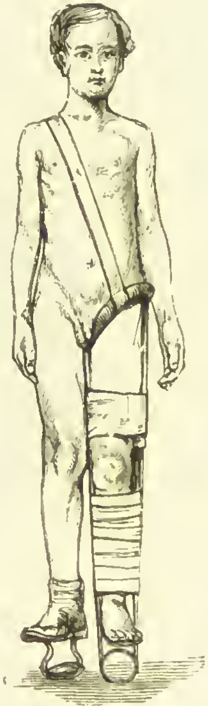


FIG. 61.—Thomas's knee-joint splint applied. Patten on sound limb. (Heath's Minor Surgery.)

During convalescence a stay at Buxton, Harrogate, Wiesbaden, or some other suitable spa may be of benefit. In *hydrops articuli* the treatment recommended above may first be perseveringly tried; this failing, the joint may be aspirated and pressure re-applied. Should it refill, it may be injected with iodine, or in very severe cases laid open and drained.

ACUTE ARTHRITIS is the term applied to a general inflammation of all the tissues of a joint. It may begin in the synovial membrane, in the articular ends of the bones, or in the tissues around, but in whatever way it begins the whole joint rapidly becomes involved in the inflammatory process.

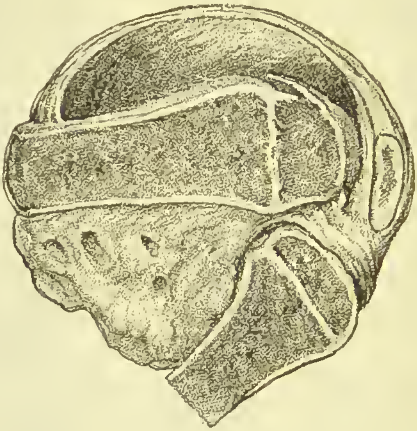


FIG. 62.—Acute arthritis of the knee-joint beginning in the synovial membrane. The ligaments are almost destroyed and the tibia is displaced backwards and outwards. The joint was filled with pus. (St. Bartholomew's Hospital Museum.)

The *causes* are very various, and include those given under acute synovitis. Amongst the most frequent causes, however, may be mentioned penetrating wounds, infective periostitis or osteo-myelitis, epiphysitis, the bursting of an abscess in the soft parts or in the end of the bone into the joint, pyæmia, and the continued and the exanthematous fevers.

Pathology.—The course of the disease differs somewhat according to its cause and mode of origin. In a typical case beginning in the synovial membrane and running on to complete disorganization of the joint and subsequent ankylosis the following changes occur:—The inflammation rapidly spreads from the synovial membrane to the bones and surrounding soft tissues; the cartilages are destroyed; the ligaments are softened; the articular surfaces are displaced by the action of the muscles; and the joint is converted into the cavity of an abscess (Fig. 62). The capsule of the joint now gives way, allowing the inflammatory products to escape. The soft tissues break down into pus, and the abscesses open externally, forming sinuses leading down to the joint. Should the inflammation now subside, granulations spring up from the denuded ends of the bones, the two layers of granulations unite, and after passing through a fibrous stage undergo ossification (*bony ankylosis*), leaving the patient with a stiff joint. The pathological process by which these changes are brought about is as follows:—The synovial membrane, which at first appears red and injected, rapidly becomes infiltrated with inflammatory products, and is converted, together with the adjacent capsules, into a thick layer of granulation-tissue. The inflamed articular ends of the bones also become infiltrated with inflammatory products, and pass through the changes described under rarefying osteitis. The cartilages thus cut off from their nutrient supply lose their lustre, and while portions die and are cast off into the interior of the joint, the rest is invaded both on its free and deep surface by the granulations derived from the synovial membrane on the one hand, and from the articular end of the bone on the other. As the result of this invasion, the cartilaginous matrix liquefies, and the cartilage cells proliferate, while the brood of young cells thus formed in part coalesce with the cells of the invading granulation-tissue, and in part escape into the joint in the form of pus. After the inflammatory products have escaped, should the inflammation subside, the layers of granulation-tissue, which spring up from the surface of the bones that have been denuded of their cartilage, come into contact, and unite in the way described under union of the soft parts by the third intention. Ossification subsequently ensues. Under less favourable circumstances the inflammation may assume a septic character, and the abscesses around the joint burrow widely among the muscles and other soft tissues. Or the periosteum or the medulla of the bones may become involved in the septic inflammation, and extensive caries or necrosis ensue. The septic products may become absorbed, and the patient die of sapræmia or pyæmia, or suppuration may continue and death result from hectic or lardaceous disease.

Signs.—The disease may begin like an ordinary attack of synovitis, but the pain soon becomes intense and agonizing on the least movement, the heat more marked, and the skin often covered by a blush of redness. The swelling at first takes the form of the synovial membrane, but soon becomes general, and the joint assumes a flexed position. In the meantime the constitutional disturbance is severe, the temperature high, the pulse rapid, the tongue furred, and a chill or rigor may perhaps occur. Painful startings of the joint now set in, in consequence of the reflex irritation of the muscles; abscesses form and make their way to the surface, and burrow in the tissues around; and the joint-surfaces become displaced from each other (Fig. 62). After the abscesses have opened, the inflammation may subside, probably leaving the joint stiff; or the patient may die of septic poisoning or of exhaustion.

The *Treatment* at first should be similar to that of acute synovitis; but should suppuration set in, the joint must be freely opened and antiseptically drained, and all abscesses that have formed around treated in the same manner. When effectual drainage cannot be secured continuous irrigation or immersion in a hot bath may be tried. If septic poisoning or exhaustion threaten life, amputation must be performed.

EPIPHYSITIS is an inflammation of the soft growing tissue between the shaft and the epiphysis; it is therefore necessarily confined to the young, and is of most frequent occurrence under the age of ten. It may be acute, subacute, or chronic, and may or may not involve the neighbouring joint. The epiphyses most often affected aro those of the hip, knee, and shoulder, but several may be implicated at the same time, or one after the other in rapid succession.

Cause.—Slight injuries, tubercle, struma, and sepsis as from the absorption of septic poison after ligature of the umbilical cord.

Pathology.—The inflammation as a rule terminates rapidly in suppuration, in which case either the articular cartilage may be perforated and the pus escape into the joint setting up acute arthritis, or the epiphysis may become completely cut off from the diaphysis and form, as in the case of epiphysitis of the upper end of the femur, a loose sequestrum in the interior of the joint. In less acute cases the inflammation may subside without suppuration ensuing, under which circumstances premature synostosis may take place between the diaphysis and epiphysis, and the growth of the bone at the affected end be thus arrested. The chronic cases may also terminate in suppuration and destruction of the joint; but if this does not occur, the prolonged vascularity may lead to increased nutritive changes, and instead of growth being arrested by premature synostosis, the bone may be increased in length.

Symptoms.—Severe constitutional disturbance; swelling of the end of the bone; tenderness, heat, and sometimes redness of the skin; stiffness and fixidity of the joint; pain increased on movement; and probably, later, signs of acute arthritis, grating of the epiphysis on the diaphysis, and if the capsule of the joint bursts, the formation of a large abscess in the limb. In the chronic form the signs are those of the early stage of strumous joint disease.

The *treatment* consists in placing the limb in a corrected position on a splint, the application of a few leeches, and free incisions down to the epiphysis with antiseptic precautions as soon as there are signs of suppuration. Should it appear probable that pus is contained in the epiphysis the latter should be cautiously perforated. If the joint, notwithstanding this treatment, becomes affected, it must be laid freely open and drained antiseptically, and any sequestrum that may be present removed.

CHRONIC TUBERCULAR OR STRUMOUS ARTHRITIS, also called tumor albus or white swelling, pulpy degeneration of the synovial membrane, and fungous inflammation, is characterized by a gradual enlargement of the joint, unaccompanied by redness or much increase of synovial secretion. It begins very insidiously, is chronic in its course, and is prone to end in total disorganization of the joint. Though most frequent in the young, it may occur at any age.

Causes.—It is generally attributed to some slight injury of the joint, occurring in a strumous or unhealthy subject; but frequently no history of any such injury is forthcoming. By many pathologists it is believed to depend in some way upon the presence of the tubercle bacillus which has gained admission to the system in the way described under Tubercle. It is a fact that the tubercle bacillus, when carefully searched for, can generally be found in the diseased tissues of the joint; but whether in such cases it is the cause of the disease, or the diseased tissue itself merely forms a suitable nidus for the growth of the bacillus, is still open to question.

Pathology.—The disease may begin either as a chronic inflammation of the synovial membrane, or as a fungating caries of the articular ends of the bones; in the former case, the synovial membrane which first appears red and injected, gradually becomes thickened and œdematous, and ultimately pulpy and gelatinous and in places fatty looking. The synovial fluid in the meantime becomes turbid or muco-purulent, but is rarely much increased in quantity; the synovial tufts, at first soft and flocculent, gradually assume the form of spongy granulation-tissue, and grow over the cartilage from the sides till they completely cover it, "lying over it like a veil." Prolongations from this veil of granulation, compared by Billroth to the roots of ivy penetrating a wall, insinuate themselves into and spread in all directions through the cartilage, which they ultimately destroy, and then in like manner invade the bone. The granulation-tissue may also make its way between the bone and the cartilage, and unite with that derived from the synovial membrane, thus leaving portions of cartilage loose between the two layers of granulations. At the same time, fungous granulations derived from the synovial membrane may invade the tissues around the joint, and undergoing caseous or fatty degeneration in places, break down into abscesses which may open both externally and into the joint, leading to the production of sinuses and fistulæ. The ligaments being thus softened and destroyed, allow the articular surfaces to be dislocated by the contraction of the muscles; whilst the muscles and bones themselves, partly from want of use and partly from the debilitating nature of the disease, undergo atrophy and fatty degeneration. *When the disease begins in the bone* it takes the form of a rarefying osteitis, the fungating granulations invade the deeper surface of the cartilages, perforate them, and then set up the changes in the synovial membrane and other tissues described above. *The minute changes* which occur during the above-mentioned phenomena are those already described under inflammation. All that need be repeated here is, that the synovial membrane, ligaments, and in places the surrounding tissues, become infiltrated with leucocytes, and ultimately converted into a layer of vascular granulation-tissue; that the cartilage-cells proliferate whilst the matrix undergoes softening and liquefaction; and that the articular ends of the bones are eroded and destroyed in the way described under Caries. In places in the granulation-tissue are found non-vascular areas, consisting of tubercle nodules, in which the tubercle bacillus has been found. It is the presence of these nodules and of the bacillus that has led to the belief that the disease is of tubercular origin. In the early stages under appropriate treatment the inflammation may subside, and the joint resume its normal condition. After the cartilages, however, have been destroyed, such a favourable ending is of course impossible, and all that can be hoped for is, that the layers of granulations covering the denuded bones may unite and ankylosis ensue. The dangers to be apprehended are that the tubercle should become disseminated, lighting up phthisis, meningitis, &c.; or that long continued suppuration should induce hectic, exhaustion, or lardaceous disease.

Signs.—The disease is generally chronic, often lasting for years. It usually begins very insidiously; there may be some slight stiffness of the joint, attributed perhaps to a trivial injury, or in the case of the lower extremity a slight limp in walking. The joint may be held in a slightly-bent position, and the range of flexion and extension may be somewhat restricted. Occasionally the disease is ushered in by an acute attack of synovitis. At first there may be little or no swelling, or the swelling may take the form of the synovial membrane; but as the disease advances, it becomes general and uniform, so that the points of bone about the joint become obscured. The wasting and atrophy of the tissues of the limb, however, give the articular ends of the bone the appearance of being considerably enlarged. In the meantime, there is no redness of the skin; hence the name tumor albus, or white swelling. Pain at first may be absent, or only present on movement of the limb, but gradually increases till the patient, in the case of the lower extremity, is prevented by it from walking. There is usually but little heat. In this condition the joint may remain for many months, and under appropriate treatment the disease may completely subside. If neglected, however, the articular surfaces of the bones, as the ligaments become softened, are slowly displaced, and painful startings of the limb at night indicate that the bones are involved. Now tenderness followed by fluctuation may be detected at one or more spots; the skin becomes red in these situations; and the abscess if not opened, bursts externally, allowing of the escape of curdy pus. Thus, by the formation of successive abscesses, the tissues around the joint are slowly undermined, and sinuses and fistulæ are formed. The general health becomes more markedly affected, and although even now the sinuses and fistulæ may heal and the patient ultimately recover, suppuration as often continues, hectic sets in, and the patient dies of exhaustion, or succumbs to phthisis or lardaceous disease.

The *treatment* must be both local and constitutional. The local indications are (1), to place the joint at absolute rest in a position in which it will subsequently be most useful should ankylosis occur; (2), to keep it at rest, not only till all signs of the disease have disappeared, but for some months afterwards, to prevent a relapse; (3), to open and drain antiseptically any abscess that may form, or fully expose the cavity of the joint and remove the diseased tissues; and (4) in advanced and intractable cases to save the patient's life by the sacrifice of the limb. For keeping the joint at rest, splints may be employed similar to those mentioned under chronic synovitis; and in the case of the lower extremity, where there may be flexion of the hip or knee, the patient should be placed in bed, and extension made by a stirrup, weight and pulley, till the deformity has been overcome. The time the splints should be worn will vary in each individual case according to the progress of the disease. Roughly, it may be said that they will generally be required for many months, perhaps for several years, and that they must be worn three months after the disease has ceased. The constitutional means which must be adopted, are those that have already been described under the treatment of Struma. Should the disease progress in spite of treatment the joint may be freely opened and the diseased synovial membrane scraped or cut completely away (*arthrectomy*), or if the cartilages and articular ends of the bone are found much diseased, the joint excised. Where however abscesses and sinuses have formed and notwithstanding antiseptic drainage the patient is becoming exhausted by long-continued suppuration and hectic, or, where signs of incipient phthisis or lardaceous disease are becoming manifest, the question of amputation must be raised.

TUBERCULAR OR STRUMOUS DISEASE OF THE HIP, though essentially similar to strumous disease of other joints, requires separate mention, as, owing to the depth and conformation of the articulation it is attended with special symptoms, and calls for certain modifications in the method of treatment.

Signs.—In the early stages there is slight lameness, some limitation in the range of movement of the joint, generally pain, and often quite early some atrophy and wasting of the muscles. The pain, though at times severe, is more frequently slight, and may only be elicited on making certain movements of the joint. It may be felt in the hip, or as is commonly the case, be referred to the knee or to other parts supplied by the obturator nerve, as the inner side of the thigh. At times it may be felt in both hip and knee simultaneously. The joint is slightly stiff, not only on flexion and extension, but also on rotation and on abduction and adduction, especially in the semi-flexed position. There is often some fulness about the front of the joint, loss of the gluteal fold, and perhaps tenderness on pressure. The joint becomes at first slightly flexed, everted, and abducted, *i.e.*, it assumes the position in which the ligaments of the inflamed joint are most relaxed—the position of greatest ease. In order to bring the flexed and abducted limb to the ground, the pelvis is depressed on the affected side, and hence the limb appears when placed parallel to its fellow slightly lengthened (Fig. 63, A and B). Later, the joint becomes further flexed; but inverted instead of everted, and adducted instead of abducted, a change of position which has been variously attributed to erosion of the posterior part of the acetabulum, a yielding of the ligaments, or exhaustion of the external rotator and abductor muscles. To overcome this position of adduction in which the limb is useless, the pelvis is raised on the affected side, so that the limb if brought parallel to the other, now appears slightly shortened (Fig. 63, C. and D) in place of being lengthened. Whilst the position of abduction and adduction is overcome by depressing or raising the pelvis respectively on the affected side, *i.e.*, by laterally bending the lumbar spine, flexion is overcome by rolling the pelvis forward, *i.e.*, by increasing the normal lumbar curve. Hence when the patient is laid on his back and the limbs are brought down parallel to each other, there is always considerable lordosis of the lumbar spine, which, however, disappears on flexing the affected limb to the angle at which it is held flexed by the contracted muscles. Later in the disease real shortening ensues, owing to the destruction of the joint and the dislocation of the head of the bone on to the dorsum of the ilium. Finally sinuses may form about the joint and the disease may progress in the way described under Tubercular Arthritis in general.

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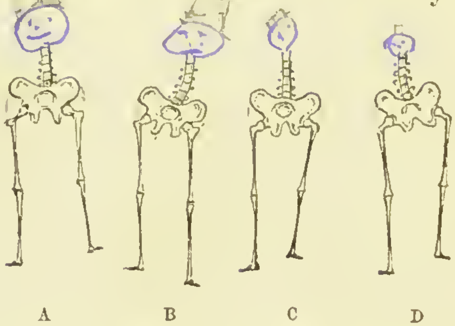


Fig. 63.—To show the effects of abduction (A), and adduction (C) in causing apparent lengthening (B), and apparent shortening (D) of the limb in hip-joint disease, when the affected limb is placed parallel to the opposite limb.

Treatment.—As regards constitutional treatment nothing need be added to what was said on p. 46. The indications for the local treatment are similar to those for strumous disease of the joints generally; but require certain modifications in the methods of carrying them out. Thus if the symptoms are acute the patient should be placed in bed, and extension made by the stirrup, weight and pulley in the direction in which the joint is displaced, the limb being gradually brought down in this way to a straight position. If the child is restless a long splint should be placed on the opposite limb to keep him from rolling to one or other side, whilst the foot of the bed should be raised by blocks to prevent him slipping down. Subsequently, or at once in subacute cases, a Thomas's splint should be applied, and after the limb has been brought into the straight position, the patient may be allowed to get about on crutches. If in spite of treatment, the disease progresses, and pus forms, early incision and drainage, the excision of the head of the bone and scraping away of the diseased tissues, or amputation at the hip joint may become necessary.

CHRONIC OSTEO-ARTHRITIS, also called rheumatoid arthritis, or arthritis deformans, is an incurable and progressive disease leading to great deformity and at times to complete disablement of the joint. It is characterized by gradual degeneration and destruction of the cartilages, eburnation and alteration in the shape of the articular ends of the bones, and formation of nodular osteophytes in the fibrous tissue around the joint. It is a disease of middle and advanced life, and may be confined to one or more of the larger joints—the hip, knee or shoulder (*monarthritis*), or it may affect many joints, including the smaller articulations (*polyarticular rheumatism*). Though most frequently met with in the joints of the extremities, it may affect other joints, as those of the lower jaw, spine, &c.

The *cause* is not known. The disease, however, has been attributed to deficient or perverted innervation, depressing nervous influences, exposure to cold and damp, improper feeding, insufficient clothing, etc. At times a slight injury appears to be the determining cause.

Pathology.—The disease is variously believed to begin as a chronic inflammation of the synovial membrane, a fibroid degeneration of the cartilages, or as an inflammatory affection of the ligaments. In whichever way it begins, however, the earliest characteristic changes are found in the cartilages. These at first appear nodular and cracked, but subsequently become rough, fibrous and villous-looking, and are finally rubbed away by the friction of the articular surfaces of the joint on each other. Such changes appear to be due to fibroid degeneration, or splitting of the matrix into fibres, and the multiplication, enlargement, and fatty degeneration of the cartilage-cells. Thus it will be perceived that the process by which the cartilages are destroyed in chronic osteo-arthritis differs materially from the so-called ulceration of cartilage which occurs in the inflammatory joint-affections previously described, and in which the matrix undergoes liquefaction and softening consequent upon its invasion by the granulation-tissue derived from the synovial membrane and bone. In chronic osteo-arthritis the synovial membrane, at first dry, becomes slightly thickened and vascular, and moderately distended with turbid synovial fluid, which at times resembles train oil. In the meanwhile the synovial fringes become hypertrophied, and assume the form of pedunculated processes, often containing little masses of cartilage or bone. These little masses may subsequently become detached and form loose bodies in the joint (Fig. 64). The articular surfaces of the bone become smooth, hard, polished, eburnated or porcellaneous in appearance and variously altered in shape—changes apparently depending in part on friction and mechanical pressure, and in part on the formation of new bone in the cancellous spaces, whereby the bone is rendered harder and is capable in consequence of receiving a higher polish. Whilst, however, new bone is being formed immediately beneath the polished surface, rarefaction and atrophy are going on a little deeper in the bone, and lead to the shortening and distortion so commonly observed. Hence, for example, the flattening and enlargement of the acetabulum and glenoid cavity, and the absorption of the neck and flattening of the head of the femur and humerus, seen in osteo-arthritis of the hip (Fig. 65), and shoulder respectively. At times the new bone in the cancellous spaces and Haversian canals is not formed as quickly as the polished layer of bone is worn away, and the open ends of the enlarged Haversian canals give the articular surface a worm-eaten appearance. In the meantime out-

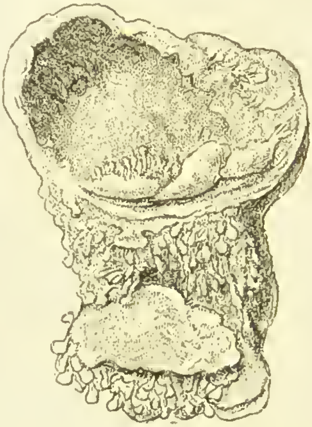


Fig. 64.—Chronic osteo-arthritis of the knee-joint. The articular surface of the tibia is shown in the upper part of the figure: the patella is turned down. (St. Bartholomew's Hospital Museum.)

growths of cartilage take place around the articular surfaces and undergo ossification, forming the low nodular flattened osteophytes and the "lipping" of the articular ends of the bone so characteristic of the disease. Ossification may also occur in the ligaments, tendons, and other soft structures around.

Signs.—When the disease is fully established it may be known by pain, increased on movement, and often worse at night and during changes of the weather; a characteristic creaking and harsh grating felt on moving the joint; the detection of masses of bone around; the limitation of the movement of the joint; and absence of heat and redness. In the hip there may be eversion, shortening and much lameness; in the knee, swelling and thickening of the synovial membrane, and deformity of the patella; and in the shoulder, enlargement or displacement of the head of the bone. In the hip the disease may closely simulate intracapsular fracture of the neck of the femur; in the shoulder, dislocation of the humerus. (See *Fracture of Femur and Dislocation of Shoulder.*)

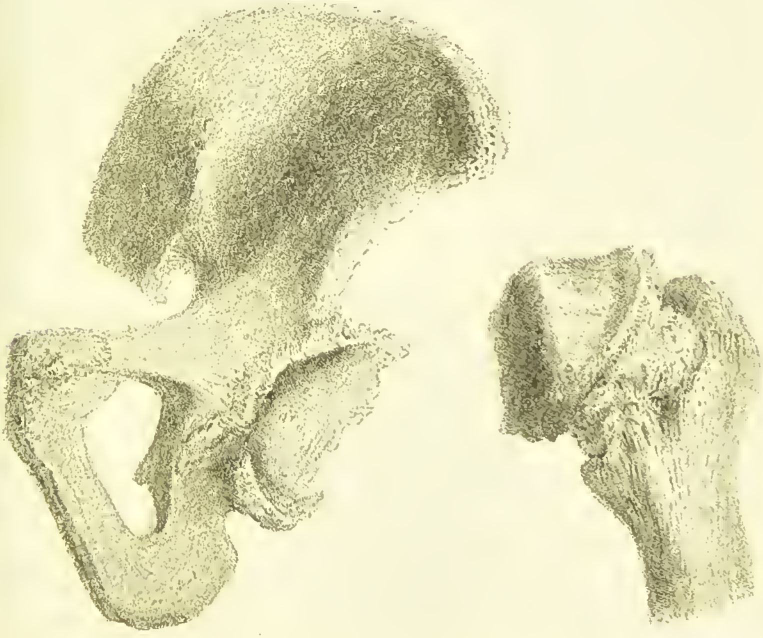


Fig. 65.—Chronic osteo-arthritis of the hip. (St. Bartholomew's Hospital Museum.)

Treatment.—Although the disease cannot be cured, and may get steadily worse as the patient grows older, much can be done in the way of relief. Thus the whole body should be warmly clad, the diet carefully regulated, stimulants prohibited or restricted in quantity, and a periodical visit paid to such spas as Buxton, Harrogate, Bath, Wiesbaden, Aix-les-Bains, or Wildbad. Locally, shampooing, friction, and passive movements, should be from time to time employed ; the joint should be enveloped in wool or flannel, but should not be kept at rest on a splint, since this will only tend to increase the stiffness. In the way of drugs, cod-liver oil, iodine, iodide of potassium, and guaiacum, are of the most service.

CHARCOT'S DISEASE is an affection of the joints closely resembling osteo-arthritis. It is believed by some to depend upon degenerations in the spinal cord (locomotor ataxia), and therefore to be the result of trophic changes in the joint. Others, however, regard it merely as an osteo-arthritis occurring accidentally in a patient the subject of locomotor ataxia. The pathological changes are similar to those already described under osteo-arthritis, but the destruction of the joint is more marked. Briefly they may be said to consist in erosion of the cartilages, softening of the ligaments, grinding away of the articular surfaces and often of the contiguous portions of the shaft of the bone, induration of the remaining portions of the articular surfaces, thickening and at times pouchings of the synovial membrane, and formation of osteophytes around. Suppuration is very rare. These changes may affect one joint only, or may occur successively in several joints.

The *signs* in a typical case are as follows:—Sudden swelling of a joint usually without much pain or any marked signs of inflammation, followed, on subsidence of the swelling, by preternatural mobility, and the formation of processes of bone about the articular surfaces and in the surrounding muscles and tendons. There is great deformity, but not much pain either on movement or handling. Along with the local signs there are generally symptoms of locomotor ataxia, such as an unsteady gait, a tendency to fall on placing the feet together with the eyes closed, a jerking movement of the limbs, absence of the patella-tendon-reflex, lightning pains, spasmodic muscular contractions, local anæsthesia and sweating of the limbs, loss of response of the pupil to light but no loss of power of accommodating for near objects (the *Argyll-Robertson test*), sometimes optic neuritis, bladder troubles, and loss of sexual power. The joints most often affected are the knee, hip, and shoulder. In the tarsus the bones on the subsidence of the swelling of the synovial membrane, though felt to be loosened by the softening of the ligaments, may ultimately become ankylosed. *Treatment.*—Beyond keeping the part at rest during an acute attack, and adopting the same general treatment as is appropriate for osteo-arthritis and locomotor ataxia, little can be done.

Loose bodies in a joint may be formed in several ways, of which the following are the chief:—1, by the proliferation of the cartilage cells that normally exist in the synovial fringes, and the subsequent detachment of the little mass of cartilage so formed through the rupture of its peduncle in the movements of the joint (Fig. 66); 2, by thickening or hypertrophy of a synovial fringe, or by extravasation and subsequent organization of blood in a synovial fringe, detachment occurring in a manner similar to that in the former case; 3, by necrosis of a portion of the articular cartilages; and 4, by chipping off of a

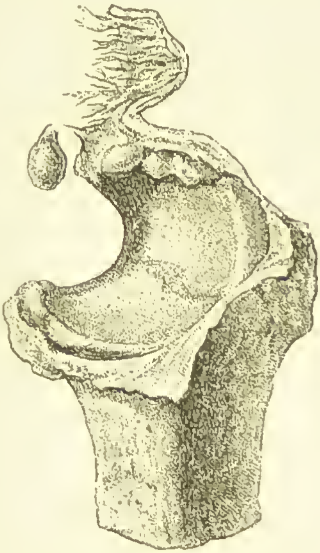


Fig. 66.—The formation of a loose cartilage in a joint. A little mass of cartilage attached by a slender stalk. (St. Bartholomew's Hospital Museum.)

portion of the articular cartilage during some injury to the joint. Loose cartilages are most common in the knee, but may be met with in any joint. They are generally single, but may be multiple, and vary in size from a pea to a walnut.

Symptoms.—The chief symptom is pain, due to the loose body slipping between the ligaments and articular surfaces during the movements of the joint. In the knee this occurs during flexion, and on the patient attempting to straighten the joint the loose body, by forcing the articular surfaces apart, stretches the ligaments, and thus gives rise to a sudden and excruciating pain, perhaps so severe as to cause him to fall. At times the loose body remains fixed between the articular surfaces, the patient being then unable to straighten his limb. Such an attack may be followed by synovitis. On examination the body may often be felt somewhere in the synovial pouch, probably on the outer side of the joint in the case of the knee. If attached, its movements will be limited, but if free it can frequently be made to move round to the opposite side of the joint. It may perhaps disappear by passing into some of the synovial recesses, though it may sometimes be felt again on moving the joint.

Treatment.—If the loose body gives rise to little or no trouble, and can be easily fixed by a pad and bandage or knee-cap, it should not be interfered with ; nor should any operation be undertaken where the joint is disorganized by osteo-arthritis, or where the synovial membrane is studded with masses of cartilage. Under other circumstances the loose body should be removed. This may be done either by the direct or the indirect method. The former consists in transfixing the loose cartilage by a strong needle on a handle thrust through the skin, so that the loose body may not slip away or be lost during the operation, and then cutting down on the capsule, and when all bleeding has been stopped, opening the joint. The body if loose will generally slip through the opening; if attached, its pedicle must be ligatured and divided. The operation should be performed with the strictest antiseptic precautions, and the patient prepared by a week's rest in bed in the case of the knee with his joint on a splint. The splint should be continued after the operation, or the joint placed in a plaster-of-Paris bandage till the wound has healed and all fear of inflammation has passed. The *indirect method* consists in incising the capsule subcutaneously with a tenotomy knife, forcing the loose body through the incision into the connective tissue around the joint, and then either allowing it to remain there permanently, or removing it after the hole in the capsule has healed. The operation is difficult to perform, and since the introduction of antiseptics possesses no advantage over the direct method.

ANKYLOSIS OR STIFF JOINT may be divided into the *fibrous* and the *bony*. A spurious form of ankylosis, due to the contraction of the surrounding muscles or of cicatrices after burns, may also occur, but is generally associated with some amount of fibrous ankylosis.

Fibrous ankylosis, also called ligamentous, or by some authors, false, in contradistinction to the bony which they then term true, is the union more or less complete of the articular surfaces of the joint by fibrous tissue. Thus, it may consist of—1, a mere thickening of the capsule; 2, a thickening and shortening of the ligaments; 3, the formation of fibrous bands within the joint; 4, the partial removal of the cartilages and the union of the bones by fibrous tissue; and 5, the above conditions variously combined. It may be the result of joint-disease, or of keeping an inflamed joint in too long a state of rest. Sometimes it may terminate in bony ankylosis.

Bony ankylosis is the firm union of the articular ends of the joint by bone. It is often a further stage of the fibrous variety. The articular surfaces may be united evenly and uniformly, or by irregular bridges of bone, or partly by bone and partly by fibrous tissue. The union may occur with the articular surfaces in contact in either the extended or the flexed position, or at an angle between the two (Fig. 67); or it may occur with the articular surfaces dislocated from each other. The way in which it is produced has

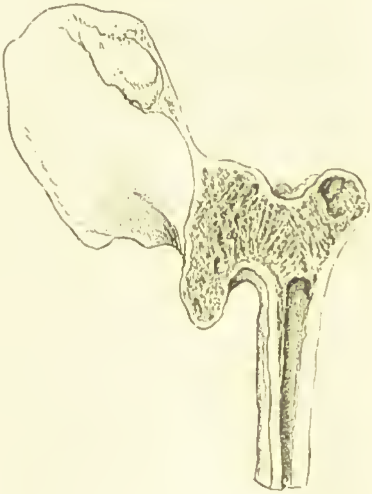


FIG. 67.—Bony ankylosis of the hip. (St. Bartholomew's Hospital Museum.)

already been described under Arthritis: all that need be repeated here is, that in strumous disease, ankylosis and caries may often be observed at the same time.

The *signs* of ankylosis are obvious—*i.e.*, the joint is stiff. It only remains to diagnose the fibrous from the bony. In the former there is slight movement, and generally pain; in the latter neither movement nor pain. In some instances, however, as in ankylosis of the shoulder and hip, it may be necessary to place the patient under an anæsthetic, as the joint may be held so firmly by the contraction of the muscles that the fibrous may simulate the bony form, and again although bony ankylosis may exist, the revolving of the scapula and pelvis on the trunk may make it appear that there is some movement in the affected joint.

The *treatment* will vary with the nature of the ankylosis. In the spurious form something may often be done by dividing the cicatrices, or by freeing the parts by a plastic operation, though in such cases the treatment is seldom very hopeful. *In the fibrous form* an attempt should be made to restore the natural movements of the joints—(1) by manipulation, friction, and passive movements; (2) by forcibly breaking down the adhesions under an anæsthetic, at the same time dividing any tendons that may offer resistance; or (3) by gradual extension by a weight and pulley, or some form of cogwheel or screw apparatus. An attempt to break down adhesions, however, should on no account be made whilst any signs of inflammation remain, and after the operation the limb should be placed on a splint for a few days, and cold by means of Leiter's tubes or an ice-bag applied to prevent inflammation. *Bony ankylosis*, with the limb in a good position, is often the best result that can be hoped for after the disease of the joint has reached a certain stage. But in some instances an operation may be required to restore movement, or to rectify a faulty position. Thus in an ankylosed elbow, especially when fixed in the extended position, excision of the joint should be practised. In a bent knee, a wedge-shaped piece may be removed, or an osteotomy done. In the hip, subcutaneous osteotomy of the neck of the femur or of the shaft just below the trochanters may be undertaken. In the shoulder, no operation as a rule is required, as the movement of the scapula on the trunk is very free. When ankylosis is accompanied by much wasting of the limb, amputation may be necessary.

NEURALGIA OF JOINTS.—Pain of a neuralgic character unassociated with heat, redness, swelling, or physical sign of organic disease, is occasionally met with in one or more joints, especially in young women of the neuro-mimetic temperament. They are very difficult cases to deal with, and should receive the greatest care and attention, lest an erroneous diagnosis be made. Nearly all varieties of organic joint-disease may be simulated; thus, there may be pain on movement, or some slight redness and heat of the part, or fixity of the joint. The pain, however, is generally superficial, and is not increased on movement of the joint if the patient's attention in the meanwhile is otherwise engaged; the redness and heat will often be found on enquiry to be due to previous friction or the use of irritants; and under an anæsthetic the rigidity of the joint completely disdisappears, its movements then being found to be free, smooth, and natural. Further, on recovery from the anæsthetic, the rigidity does not return until the patient again directs her attention to the joint, whereas in organic disease it returns as soon as the muscular relaxation ceases. The *treatment* consists in the employment of the ordinary remedies for neuralgia, both locally and internally. Where the patient is of a neuro-mimetic temperament, and organic disease is simulated, appropriate hysterical treatment must be adopted. *See a work on Medicine.*

ARTHRECTOMY OR ERASION OF JOINTS consists in scraping or cutting away the whole of the diseased synovial membrane, after the cavity of the joint has been fully exposed by some such incision as that employed in excisions. It is a useful addition to our methods of treating diseased joints, and appears to be especially indicated for those cases in which the disease is too far advanced to yield to the ordinary plan of treatment, but has not as yet, or at least only to a slight extent, involved the cartilages and bones.

EXCISION OR RESECTION OF JOINTS consists in cutting away the articular surfaces of the bones entering into the affected joint, or in removing a portion of bone where osseous ankylosis has taken place. When excision is done for disease it may be said here to prevent repetition that the whole of the diseased synovial membrane should be cut or scraped away, as should also the lining membrane of any sinuses that may be present. Excision may be required for severe injury or for intractable disease of the joint. Space does not permit of the discussion of the various conditions under which excision should or should not be performed, but it may briefly be stated that it should *not* be undertaken—1, when the disease is acute; 2, when there is much destruction of the bones, or riddling of the soft parts with sinuses; 3, when there is much atrophy of the bones and muscles: 4, when the patient is under the age of ten or over that of thirty, as in the former instance, the epiphyses are liable to be removed, and the growth arrested in consequence, and in the latter, the powers of repair are usually insufficient to ensure sound healing and a subsequently useful limb; 5, when there is lardaceous disease or signs of phthisis, or other organic mischief; 6, when the patient's condition is such that he would be unable to stand the exhaustion of the long-continued suppuration. Under most of the above circumstances amputation is generally indicated. Excision is usually attended with the best success in the elbow, and here it may be done at a later period of life than that assigned above as the limit. In the shoulder, elbow and wrist, fibrous ankylosis is aimed at in order to secure a movable joint; in the hip and knee, firm bony union is sought in the most useful position of the limb, which is that of extension.

EXCISION OF SPECIAL JOINTS.—THE SHOULDER.—Excision of the shoulder is generally practised for gunshot injuries and for innocent tumours in the head of the bone. It is seldom performed for disease of the joint, as an equally useful joint may be obtained by osseous ankylosis. It should never be done for osseous ankylosis, as the movements of the scapula on the trunk are so free, that they compensate to a great extent for the fixed condition of the joint, and little would be gained by the operation. *The operation.*—Make an incision from the acromion through the substance of the deltoid down to the bone; detach the long tendon of the biceps from its groove, and give it to an assistant to hold aside with blunt hooks. The arm being rotated inwards, divide the teres minor, infraspinatus, and supraspinatus tendons at their insertion into the bone. The arm being next rotated outwards, divide the tendon of the subscapularis, and the head of the bone can be pushed out of the incision. Separate the periosteum as far as is necessary, place a retractor behind the neck of the bone to protect the soft parts, and saw it across. Bring the wound together by suture, placing a drain-tube in the lower part.

THE ELBOW may be excised for chronic disease of the joint, gunshot or other injury, and osseous ankylosis. Some surgeons only recommend excision for ankylosis, when the elbow is fixed in a faulty position. The operation, however, is attended with so little risk, and the advantages of a movable elbow are so great, and the results so good, that others unhesitatingly excise the joint in whatever position it may be fixed. The *operation* may be performed in several ways; but that by the single vertical incision (*Langenbeck's*) is undoubtedly the best and the one most frequently practised. Make a vertical incision about five inches long over the back of the joint, beginning about two and a half inches above the olecranon, and carry it over this process and down the ridge on the ulna for the same distance. The incision should extend in its whole length down to the bone. Cut into the joint above the olecranon and clear the condyles of the soft tissues by keeping the edge of the knife in contact with the bone, taking special care not to injure the ulnar nerve behind the internal condyle. Divide the lateral ligaments, and whilst the assistant strongly flexes the joint to force the bones out of the wound, free them from their remaining connections, and saw off the olecranon, the head of the radius, and the lower end of the humerus, steadying the parts with the lion forceps. If possible, the coronoid process of the ulna and the tubercle of the radius should not be removed, and the shaft of the humerus not encroached upon. Preserve the connection of the anconeus with the triceps, as better extension of the arm will be thus obtained. Unite the wound by sutures, after inserting a drain, and place the limb on a splint in the flexed position. Callender's splint is one of the best for the purpose, as it permits of passive motion not only in the direction of flexion and extension, but also in that of pronation and supination, and that without removing the arm from the splint. It also allows of the limb being slung by pulleys from the ceiling, which is much more comfortable for the patient than placing it on a pillow. Passive movements should be begun at the end of the first week, the aim of the surgeon being to obtain a movable joint.

THE WRIST may be excised for chronic disease of the wrist and carpal joints. The operation is very successful in suitable cases; these however are rarely met with, as if the disease is extensive, it is better to amputate, and if limited, gouging away the diseased bone will generally suffice. The *operation* usually done is that now known as Lister's. It consists in removing all the bones of the carpus, the bases of the metacarpal bones, and the lower end of the radius and ulna, the incisions being so planned as to avoid cutting the numerous tendons surrounding the joint and the radial artery. As the operation is rarely performed, further details will not be given.

THE HIP may be excised—(1) when the head of the bone has become necrosed, and lies loose in the joint; (2) when suppuration continues in spite of free drainage and antiseptics; (3) when in addition to suppuration the head of the bone is dislocated, and the limb cannot be placed in a useful position. Excision should not be done when there is extensive disease of the pelvis or femur, or signs of lardaceous disease or of phthisis. Under these circumstances amputation is the only resource. For ankylosis in a faulty position subcutaneous osteotomy of the neck of the femur or of the shaft of the bone below the trochanters is preferable to excision. *The operation.*—1. By the *posterior* incision. Make an incision about four inches long behind the great trochanter, and after dividing the glutei, open the capsule, insert the finger, and with this as a guide, saw through the neck of the femur with Adams's saw, or Gowan's osteotome, and remove the head thus detached with sequestrum forceps. The trochanter should be spared if possible. Examine the acetabulum, and remove any carious bone or sequestrum that may be discovered with the gouge or sequestrum forceps. Place the limb in the position of abduction on a Thomas's splint, so as to bring the stump of the neck into the acetabulum, and thus leave as little space as possible between the bones. After ankylosis has taken place the abducted position is of advantage, in that to bring the limbs parallel in walking the pelvis will have to be depressed on the affected side, and thus a good inch of lengthening is obtained to compensate for the shortening produced by the excision of the head of the bone. Some surgeons now no longer use a drain-tube, but bring the deeper parts of the wound together by buried sutures, and having lightly closed the skin incision apply firm compression over a dry antiseptic dressing, so as to keep the tissues in close apposition and thus obtain union by the first intention. 2. By the *anterior* incision. An incision four inches long is made from the anterior superior iliac spine downwards and a little inwards between the sartorius and the tensor vaginæ and glutei, and the joint opened from the front. In other respects the steps of the operation closely resemble those of the former method.

THE KNEE.—Provided none of the contra-indications to excision already enumerated are present, the knee may be excised for intractable disease of the synovial membrane, especially where the articular surfaces are much displaced, or for ankylosis in a faulty position. In the latter instance, however, a subcutaneous osteotomy is often preferable. *The operation.*—The knee being held in a flexed position by an assistant, make an incision from the posterior part of the condyle on one side, across the front of the joint midway between the patella and the tubercle of the tibia, to the corresponding situation on the other. Raise the flap of skin with the subcutaneous tissue thus mapped out, and open the joint by cutting into it above the patella. Divide the lateral and crucial ligaments, and saw off a thin slice of bone from the lower end of the femur and from the upper end of the tibia, taking care not to injure the popliteal artery which lies close to the back of the joint and is only separated from it by the posterior ligament. If possible, the whole of the epiphysis should not be removed. The wound should then be closed with sutures, a small drain being inserted on each side. The articular surfaces are best secured in apposition by long bone pegs driven in through the skin obliquely on either side of the joint, holes having been previously drilled for them by a steel needle devised for the purpose. The pegs may then be cut off short and left in permanently. Mr. Morrant Baker in place of the bone pegs leaves the steel needles *in situ*, and removes them when union has occurred. Tenotomy of the hamstring tendons may be required to bring the bones into apposition if there has been much displacement. The limb should then be placed on a Gant's or other form of excision-splint; but the kind of splint is not very material if the bones are well secured in good position by the pegs in the way described above. After convalescence the knee should be kept for at least a year in a well-fitting leather splint, as there is a great tendency for the bone to yield and the joint to become flexed.

THE ANKLE.—Excision of the ankle is too rarely required in practice to call for a description. The results following it, moreover, are so unsatisfactory, that in disease of the ankle-joint either Syme's operation, or amputation through the lower third of the leg, is nearly always done in preference.

DISEASES OF MUSCLES.

INFLAMMATION AND ABSCESS.—Inflammation of muscle, or *myositis*, may be due to a sprain, partial rupture, or other slight injury, or to rheumatism or pyæmia, or it may spread to the muscle from the surrounding tissues. Except in the pyæmic form it generally ends in resolution. *Signs.*—Pain, swelling, rigidity, and more or less fever, followed by signs of an abscess should suppuration ensue. *Treatment.*—Rest, anodyne liniments to assuage pain, and a free incision if pus forms.

GUMMATA may be met with in muscle in the tertiary stages of syphilis. They are said to be especially common in the sterno-mastoid of infants the subjects of congenital syphilis; but it is probable that many of the localized swellings in the sterno-mastoid of infants are due to partial rupture during birth.

ATROPHY AND DEGENERATION of muscle merely require mention. The chief degenerations are—1, simple atrophy; 2, fatty degeneration; 3, granular degeneration; and, 4, waxy or vitreous degeneration. *In simple atrophy* the muscles merely waste, but do not lose their striation, and are capable of being restored to their normal condition; whereas the fibres of a degenerated muscle are altered in their anatomical structure, and their function is entirely and permanently lost. Simple atrophy may occur from many causes. It is generally seen in surgical practice as the result of long disuse of a limb, as in chronic joint disease, but it is then usually associated with some amount of degenerative change. Fatty, granular, and waxy degeneration, though sometimes met with singly are more often found combined in the same muscle. They occur in acute febrile diseases, scrivener's palsy, progressive muscular atrophy, infantile paralysis, pseudo-hypertrophic paralysis, &c.

HYPERTROPHY of muscle calls for no special remark. A familiar example of hypertrophy of the voluntary muscles is seen in the limbs of athletes; of hypertrophy of the involuntary muscles, in the muscular coat of the bladder which has become thickened in its efforts to overcome the obstruction of a stricture.

OSSIFICATION OF MUSCLE may occur as the result of chronic irritation. As examples may be mentioned the *rider's bone*, or ossification of the adductors, occasionally met with in persons who ride a great deal; the *drill bone*, or ossification of the deltoid in soldiers as the result of shouldering arms; and the ossification of the rectus and other muscles in Charcot's disease of the joints.

TUMOURS.—Although primary tumours are not common in muscle, nearly all varieties except carcinoma have at times been met with. Sarcoma occurs, perhaps, the most frequently.

DISEASES OF TENDONS.

SIMPLE TENO-SYNOVITIS or inflammation of the sheath of a tendon may be acute, sub-acute, or chronic. It is most frequently met with in the sub-acute form and in the extensors of the thumb and wrist as the result of over-exertion—a hard day's rowing, and the like. In this situation, it produces an elongated swelling over the extensors of the thumb, and is attended with pain on pressure and movement, and a characteristic creaking sensation. In the acute form suppuration may occasionally occur. *Treatment.*—Rest on a splint, painting with tincture of iodine, and strapping will generally suffice. In the acute variety, leeches, or free incision if pus forms, and passive movements to prevent adhesions. In the chronic, counter-irritation in the form of blisters, and pressure by means of strapping followed by elastic support.

GANGLION is a simple or compound cyst formed in connection with the sheath of a tendon. It is generally due to continued strain or teno-synovitis. A *simple ganglion* may be produced by—1, the cystic transformation of the cells in the synovial fringes; 2, the dilatation of the sub-synovial follicles; and 3, the pouch-like protrusion of the synovial lining of the tendon through the fibrous sheath, with the subsequent obliteration of the neck of the pouch. Simple ganglia are most common on the extensor tendons at the back of the wrist, but occur in other situations, as the front of the wrist and ankle, and on the sheaths of the flexor tendons near the web of the fingers. They form smooth, generally globular, often translucent, tense or semi-fluctuating moveable swellings, evidently in connection with a tendon, and varying in size from a pea to a pigeon's egg. They contain a clear jelly-like fluid, and sometimes *melon-seed-like bodies.* The only inconvenience to which they give rise is a feeling of weakness in the wrist or fingers; they are seldom attended with pain. Simple ganglia are sometimes simulated by pouch-like protrusions of the synovial membrane of the carpus and tarsus. The deep attachment of these synovial pouches, their non-connection with a tendon, and the concomitant swelling of other parts of the synovial membrane are points which may serve to distinguish them. *Treatment.*—They may often be broken by pressure with the thumbs; otherwise they may be punctured with a tenotome, the skin being drawn aside to make the opening valvular, and the contents squeezed out. In either case firm pressure must subsequently be applied by strapping and a bandage. Should they refill, a second puncture may be made, and the interior scarified by the point of the tenotome. This failing, the cyst may be laid open and allowed to granulate from the bottom, or it may be dissected out.

A *compound ganglion* consists of the dilatation of the sheath of several tendons. It is most common in connection with the flexor tendons where they pass under the anterior annular ligament of the wrist, and is then spoken of as the *palmar bursal ganglion.* The walls frequently become thickened and villous-like on their internal surface, whilst *melon-seed-like bodies* are frequently found free in the interior of the ganglion or attached by slender peduncles to its walls. The fluid contained in the cyst may be clear and serous, or thick and gelatinous, and of a dark chocolate colour. These ganglia have lately been described as arising from a tuberculous degeneration of the sheaths of the tendons, similar to pulpy degeneration of a joint, and the tubercle bacillus has been found in them. *Signs.*—A palmar bursal ganglion forms a tense elastic swelling, constricted at its centre by the anterior annular ligament. The swelling projects both in the wrist and in the palm, and occasionally extends along the flexor tendons of the thumb and little finger. Fluctuation may be obtained by pressing alternately above and below the annular ligament. Operative *treatment* is always attended with some risk—such as stiff wrist or fingers from the glueing together of the tendons, suppuration extending up the planes of the flexor muscles into the forearm, acute cellulitis, erysipelas, sapræmia and pyæmia. An operation, therefore, should only be undertaken when necessitated by loss of power in the wrist or fingers, and even then not until an attempt has been made to cure the ganglion by pressure, strapping, and counter-irritation. Should an operation become requisite, it is best, in my opinion, to make an antiseptic incision above and below the annular ligament, squeeze out the melon-seed bodies and insert a drain-tube. The forearm and hand should be confined on a splint.

Paronychia tendinosa, a variety of whitlow, is an acute infective inflammation of the sheath of a tendon, generally of a finger, more rarely of a toe. It is usually the result of inoculation with a septic or infective poison in a person who is out of health. It may begin in the sheath of the tendon, or in the tissues superficial to the sheath, or in the periosteum of the phalanx. If neglected, very serious consequences may ensue; thus—1, the tendon may die from its blood-supply being cut off by the inflammatory effusion; 2, the suppuration may extend into the palm, and under the annular ligament into the forearm; 3, the inter-phalangeal, carpal, or wrist joint may become involved in the inflammation and destroyed; 4, the phalanx may necrose; 5, septicæmia or pyæmia may ensue, *Signs.*—Intense and throbbing pain, acute tenderness on pressure, and swelling and induration of the finger, followed by a similar condition of the palm, and often by great œdema of the back of the hand, which may perhaps extend up the forearm. The lymphatics may become tender and inflamed, and the lymphatic glands in the axilla enlarged. Exhaustion from pain and want of sleep, feverish symptoms, and at times signs of blood-poisoning may ensue. *Treatment.*—The chief indication is to relieve tension, and thus prevent the strangulation of the vessels and consequent death of the tendon, and the spread of the inflammation into the palm or to the periosteum covering the phalanx. Thus a free incision should be made in the middle line of the finger extending into the sheath, or to the bone if the periosteum is affected, and the wound dressed with iodoform or other antiseptic. Should suppuration occur in the palm or forearm the pus must be let out by timely incisions. The pain in the meanwhile will be greatly relieved by placing the whole forearm for several hours at a time in a bath kept at a temperature as high as can be borne. Corrosive sublimate or carbolic acid should be added to the water. A purge at the onset is generally required, and opium is usually needed to relieve the pain. The patient at first should be confined to a slop diet, but later a stimulating plan of treatment is commonly called for. Should any stiffness of the part remain after the inflammation has subsided, an attempt should be made to overcome it by passive movements, massage, &c. Dead bone must be removed when loose, and amputation of the affected finger, or even, in severe cases, of the forearm, may become necessary.

DISEASES OF FASCIÆ.

DUPUYTREN'S CONTRACTION of the palmar fascia is the only affection of the fasciæ requiring notice. It has been attributed to gout and rheumatism, and to habits or occupations necessitating pressure in the palm or flexion of the fingers. It consists in a shortening of the prolongations of the fascia from the palm on to the sheath of the flexor tendons. The tendons themselves are not affected. The contraction generally begins in the fascia of the little or ring finger, and later may affect that of the middle finger, and at times the fore-finger and also the thumb. The affected fingers (Fig. 68) are drawn towards the palm, and in severe cases may become fixed in contact with it. The skin being adherent to the fascia, is thrown thereby into transverse puckers. The affection may be distinguished from a contracted tendon by the latter forming a tight cord, which can be traced under the annular ligament, and by the skin in the case of the contracted tendon being free. *Treatment.*—Except in the early stages, when steps should be taken to prevent further contraction by suitable splints, elastic tension, &c., division of the affected portions of the fascia, followed by extension, or the excision of the contracted band through

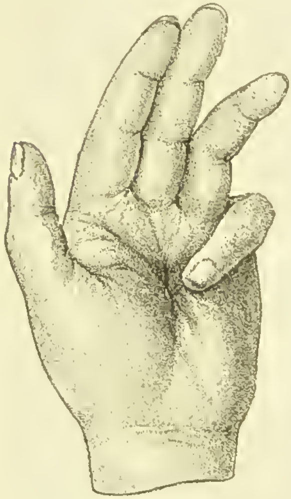


FIG. 68. — Dupuytren's contraction of the palmar fascia. (From a cast in St. Bartholomew's Hospital Museum.)

an open antiseptic incision is requisite. Subcutaneous division may be done by single or by multiple puncture. Multiple subcutaneous division is, in my opinion, the preferable method. The incisions should be made opposite the puckers, not in the creases, to prevent the wounds from gaping when the fascia is stretched. An apparatus should be worn for many months to prevent recontraction.

DISEASES OF BURSÆ.

Bursæ, wherever situated, and whether existing naturally or formed adventitiously, are liable to become acutely or chronically inflamed.

Acute bursitis may occur spontaneously, but is generally excited by injury, or undue pressure as from constant kneeling. The inflammation comes on rather suddenly, the part appearing red, hot and swollen: it is apt to terminate in suppuration, which if timely incisions are not made may become diffuse and phlegmonous. Evaporating lotions, an ice-bag or a few leeches, may, if applied early, check the inflammation; but a free incision must be made as soon as there are signs of suppuration.

Chronic bursitis is very apt to occur in bursæ that are subjected to continued pressure or irritation, and may lead to several distinct conditions. Thus, 1. *Bursæ may become simply enlarged and distended with bursal secretion.* In this state they form globular, fluctuating, often translucent, tense, or flaccid swellings; their walls are but slightly thickened; and there is no heat or redness of the skin. 2. *They may become enlarged, slightly thickened, and distended with a serous or dark fluid containing small masses of fibrin resembling melon-seeds.* These melon-seed bodies may be formed from extravasated blood, fibrinous deposits, or detached portions of thickened synovial fringes, and their presence may sometimes be detected by the crackling sensation they give when the bursa is handled. Sometimes in place of, or together with, melon-seed bodies, fibrous cords are found stretching across the cavity of the bursa. 3. *They may become enlarged and their walls greatly thickened by inflammatory infiltration, and the deposit of fibrin in their interior.* A small central cavity may remain, or they may be solid throughout. They then appear as firm, non-elastic, solid-feeling tumours, and when situated over the tuberosity of the ischium, or in front of the patella, may cause much inconvenience.

Treatment.—When simply enlarged, painting with the liniment of iodine, or strapping will sometimes disperse them. If this fails they should be punctured, the fluid evacuated, the melon-seed bodies, if present, squeezed out, and firm pressure applied. When greatly thickened or solid they must be dissected out.

The situations in which these various conditions of the bursæ are most frequently met with are:—over the patella, the *housemaid's knee;* over the olecranon, the *miner's bursa;* over the tuber ischii, the *weaver's bottom* or *coachman's bursa;* over the great trochanter; under the semi-membranosus; and under the psoas tendon. Adventitious bursæ may also be found under corns or over points of bone subjected to pressure, as the metatarso-phalangeal joint of the great toe, the outer side of the foot in talipes varus, &c. (See *Bunion*, *Talipes.*)

The *bursa patellæ* is the one which is most frequently affected, and what has been said about diseases of bursæ in general applies particularly to it. When acutely and diffusely inflamed it may simulate disease of the knee-joint, from which, however, it may readily be diagnosed by the swelling in the one case being in front of the patella and in the other behind it. A few words may also be added concerning the *bursa beneath the semi-membranosus.* When enlarged it forms a tense or semi-fluctuating ovoid swelling in the popliteal space; but becomes flaccid, or disappears altogether on flexing the knee. Counter-irritation or pressure will generally disperse it. If these fail it may be punctured or incised and drained antiseptically; but the greatest precaution must be taken to prevent septic changes occurring, as it often communicates with the knee-joint.

DISEASES OF THE ARTERIES.

ARTERITIS OR INFLAMMATION of the arteries may be *acute* or *chronic.*

ACUTE ARTERITIS was formerly thought to be of frequent occurrence as an *idiopathic* affection, but as such it is now known not to exist. *Acute traumatic arteritis*, however, is very common, occurring as it does in the *simple* or *plastic* form in the process of healing of an artery after injury or ligature, or from the presence of a non-infective thrombus; whilst as a *septic*, *infective*, or *suppurative* affection it is occasionally met with as the result of the extension of septic or infective inflammation to an artery from the surrounding tissues, or as the result of the presence of a septic or infective embolus brought by the blood-stream from a like inflammation of a distant part, as the heart in ulcerative endocarditis. *Plastic or adhesive* arteritis has already been discussed under the *Healing of Arteries.* Of *septic and infective arteritis* all that need be said here is that when due to extension from the surrounding tissues it may lead to the softening and giving way of the arterial walls, and, unless a clot forms above and below, to hæmorrhage; whilst when due to an embolus it may lay the foundation of an aneurism, or, more rarely, may lead to the rupture of the vessel. It is believed to be the chief cause of aneurism in children.

CHRONIC ARTERITIS, familiarly known as *atheroma*, mainly affects the deeper layers of the intima, not, as a rule, the other coats. Hence it is often spoken of as *endarteritis.* It is the commonest disease of the arteries, and to some extent is generally present in persons over forty. It is most frequent in the aorta and large vessels, that is, in those containing the greatest amount of elastic tissue, and is more often met with in the arteries of the lower than in those of the upper limbs.

Causes.—Mechanical strain or vascular tension is looked upon as the most frequent *exciting* cause. Thus it is attributed to—1, occupations necessitating severe and prolonged exertion; 2, the abuse of alcohol, which produces an increased and forcible action of the heart; 3, chronic Bright's disease, in which the blood-pressure, in consequence of capillary fibrosis or spasm of the arterioles, is increased; 4, plethora, in which the arterial tension is also raised; 5, syphilis, which is attended by fibroid change in the small vessels and consequent increased vascular tension, and, 6, gout, in that it may produce Bright's disease. In addition, however, to the increased vascular tension to which the above mentioned conditions may give rise, gout, syphilis, and alcohol may also lead to primary degenerative changes in the coats of the arteries in common with the degenerations they induce in the tissues generally throughout the body, and hence, together with advancing age, and the male sex, men being more exposed to mechanical strains than women, may be looked upon as *predisposing* as well as exciting causes.

Pathology.—Arteritis begins as a small-round-cell infiltration of the deeper layers of the intima—those next the muscular coat. This gives rise to characteristic greyish-white, slightly-elevated, tough, semi-gelatinous patches on the inner surface of the vessel. The patches, which frequently begin around the entrance of the small lateral branches, increase by their edges, and by coalescing with other patches produce extensive tracts of the disease. The inflammatory infiltration in consequence of the absence of new vessels, may undergo—1, fatty, 2, calcareous, or, 3, fibroid degeneration. 1. The patches formerly grey become yellowish-white, breaking down into a cheesy mass or completely liquefying into a puriform fluid consisting of fatty *débris*, cholesterine-crystals, and minute oil-drops. The layers of the intima next the blood are at first continued unbroken over the fatty patch, which is then called an *atheromatous abscess*. These layers, however, may subsequently give way, leaving the softened and fatty mass in contact with the blood (the *atheromatous ulcer*). Portions of the fatty material may now be washed away by the blood-stream and become lodged in some of the smaller arteries and capillaries, where they seldom, however, do any harm, as the emboli are non-infective. At times, however, a larger vessel may become plugged, when gangrene may ensue. As the atheromatous material is washed away by the blood, fibroid thickening of the external coat and sheath of the artery takes place opposite the base of the ulcer, so preventing perforation of the artery; but as the new tissue is very inelastic it is liable to yield to the pressure of the blood and an aneurism occur. 2. Instead of the patch undergoing fatty softening lime-salts may be deposited in it. This *secondary* calcification must be distinguished from the *primary* calcification to be shortly mentioned. The intima may be continued over the calcareous patch, or it may break away, leaving it exposed to the blood current, thus constituting a nidus for the deposition of fibrin and the formation of a thrombus, portions of which again in their turn may be washed away by the blood and form emboli. 3. The small-cell-infiltration in the inflamed patch instead of undergoing either of the former changes may advance to the production of fibrous tissue, and a dense fibroid thickening result.

The effects of chronic arteritis.—1. The artery may become dilated, elongated, and tortuous; 2, it may yield at the atheromatous patch, producing an aneurism; and 3, it may rupture under violence. In addition to the above effects depending upon the loss of elasticity of the vessel, thrombosis and embolism may occur as already stated, and give rise to gangrene, aneurism, or rupture.

Signs.—Except in the superficial vessels where atheroma is productive of rigidity and a tortuous condition of the artery, it gives no special evidence of its presence.

Syphilitic arteritis.—This term is applied to a fibroid change in the arteries occurring during the later stages of syphilis. It is most common in the arteries of the brain. The inner coat is chiefly affected, and becomes greatly thickened, so that the lumen of the vessel is almost or entirely obliterated. The change consists in an extensive infiltration of small round cells, which later become developed into an imperfect fibrous tissue. The outer coat is likewise implicated, but to a less extent, while the muscular coat either escapes, or is merely encroached upon by the cells infiltrating the inner coat. The disease is very chronic, and may terminate in thrombosis, or may lead to the formation of an aneurism.

Obliterative arteritis, so called, is a rare disease, characterized by great pain spreading up the course of the artery, loss of pulse in the vessel, and often gangrene of the part supplied by it. Its pathology is not known.

PRIMARY DEGENERATION OF ARTERIES.—We have already seen that fatty, calcareous, and fibroid degeneration may follow chronic endarteritis. These changes may, however, occur as primary affections, and may next be considered.

Primary fatty degeneration begins in the superficial layers of the intima, immediately under the endothelium. It takes the form of yellowish-white patches, very slightly projecting into the vessel. The patches can be readily stripped off from the deeper layers, which when thus exposed are found healthy; whereas, in atheroma, it is the deeper layers which are the seat of the disease. It is attended with no signs, and is of little practical importance.

Primary calcification is of more importance. It should be distinguished from calcification occurring as a secondary change in endarteritis. Primary calcification begins in the muscular layer of the middle coat, and is more common in the smaller than in the larger arteries, and in those of the lower than in those of the upper extremity. It is a disease of advancing age, and is a frequent cause of senile gangrene in that the arteries are converted into rigid tubes and the circulation through them is in consequence greatly impeded. Thrombosis, moreover, is very liable to occur. In primary calcification the lime salts are deposited in the form of rings (Fig. 69) instead of in irregular patches as in secondary calcification.

Fibroid degeneration.—For a description of this a work on Medicine must be consulted.

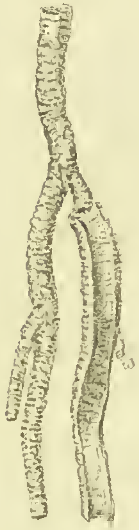


FIG. 69. Primary Calcification of Arteries.

ANEURISM.

An aneurism is a tumour containing blood and communicating with the interior of an artery. Aneurisms may be divided into two main classes, the *spontaneous*, which are the result of disease of the vessel-walls, and the *traumatic*, which are due to a direct injury of the artery and extravasation of blood into the tissues. Here the spontaneous only will receive attention. The traumatic are described under Injuries of Arteries (p. 191).

SPONTANEOUS ANEURISM. — *Cause.* — Aneurisms are most common at that age when the coats of the arteries are liable to be weakened by disease whilst the muscular system is still vigorous, and are chiefly met with among those whose occupations subject them to sudden or irregular strains. Hence, the frequency with which they occur in soldiers, sailors, and the labouring classes, and in men rather than in women. The chief *predisposing causes* are 1, *atheroma*, whereby the coats of the artery are softened and unable to resist an increased expansile pressure of the blood; and 2, *embolism* which may lead to inflammatory changes, and consequent weakening of the arterial walls. Thus the conditions which induce atheroma and embolism may also be considered as predisposing causes of aneurism. Of these, however, syphilis, the abuse of alcohol, continued vascular strain, and ulcerative endocarditis may be especially mentioned. The *exciting causes* are such as produce the rupture or yielding of the diseased coats, either (*a*) by direct mechanical violence, or (*b*) by increased blood-pressure in the vessel owing to violent and sudden action of the heart and obstruction by muscular contraction of the capillary flow. Hence, blows or strains, mental emotion, and violent and sudden exertion of all kinds may be mentioned as exciting causes.

Process of formation.—An aneurism may be formed in several ways:—1. By the simple dilatation of a diseased portion of an artery due to the yielding of the softened coats to the expansile force of the blood current. 2. By the giving way of the internal and middle coats at tho diseased spot, and the yielding of the external coat to the force of the blood. 3. By the giving way of all the coats at the diseased spot and escape of the blood into the tissues which become condensed around it to form a sac. 4. By the giving way of the external and middle coats, and the protrusion of the internal coat through them (very rare); and 5. By the giving way of the internal and part of the middle coats, and extravasation of the blood between the layers of the middle coat.

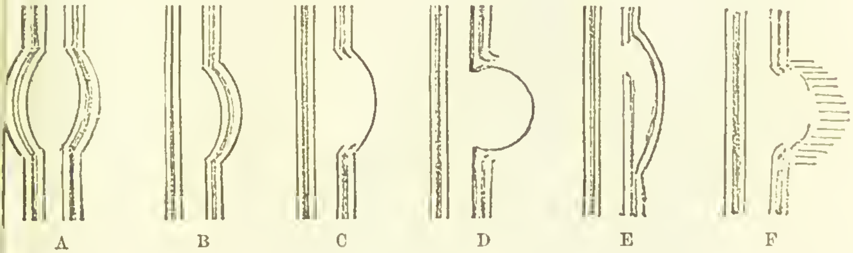


Fig. 70.—Diagram illustrating the structure of an aneurism.

Structure of an aneurism.—An aneurism consists of a sac and its contents *The sac* may consist—(1) of all tho coats of the artery (Fig. 70, A and B); (2) of the external coat only (Fig. 70, C); (3) of condensed tissues external to the artery (Fig. 70, F); (4) of the internal coat only (very rare (Fig. 70, D); (5) of the separated layers of the middle coat, between which the blood has been forced, with the external and internal coats on either side (dissecting aneurism (Fig. 70, E). The practical point, however, to be borno in mind, is that it is only whilst the aneurism is small, and then by dissection alone, that these distinctions can be made; and that as the aneurism increases in size the tissues around become condensed and blended with the sac, which may finally be formed almost or entirely of these tissues. *The contents of the sac.*—When an aneurism is first formed, the sac contains only fluid blood; fibrin, however, is gradually deposited from the blood in concentric layers upon the internal surface of the sac, so that after it has existed some time, the contents are partly solid laminated fibrin, and partly coagulated and fluid blood. Next the wall of the sac the fibrin is laminated, firm and compressed, and of a yellowish-white colour; but towards the mouth of the sac it becomes softer and moister, and of a reddish colour; whilst that in contact with the fluid blood merely resembles ordinary blood coagulum. In an aneurism that has been cured, the whole sac will generally be found thus filled with laminated clot, which has been well likened to the appearance presented by the section of an onion (Fig. 71). Where the cure has taken place in a few hours, it is probable that the greater part of the material filling the sac is merely blood coagulum, as in such instances the time would probably be too short for fibrin to be deposited.

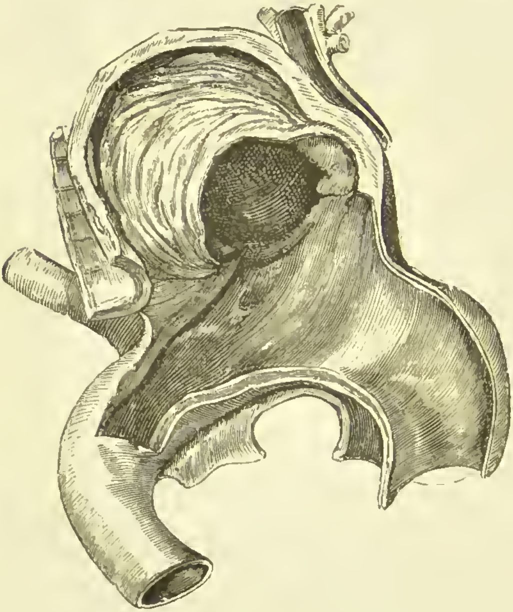


FIG. 71.—Laminated appearance of the clot filling a consolidated aneurism of the arch of the aorta.

(St. Bartholomew's Hospital Museum.)

CLASSIFICATION.—Aneurisms may be divided into the fusiform, the sacculated, and the dissecting.

1. *A fusiform aneurism* is a dilatation of the whole circumference of a portion of an artery. The sac consists of all three coats, and is continuous with the lumen of the artery at each end (Fig. 70, A). The dilated portion of the artery is also elongated, as is well seen in aneurisms of the arch of the aorta, where the three primary branches are much further apart than is natural. Fusiform aneurisms are most common in arteries that contain much yellow elastic tissue, as the aorta and its primary branches, and the contiguous portions of the iliac and femoral arteries. They often attain a large size, and after they have existed some time, frequently become sacculated from the unequal yielding of their walls. The walls themselves, though sometimes thinned, are more often thickened, and are highly atheromatous. Laminated fibrin is seldom found in them, as the circulation does not as a rule become sufficiently retarded to allow of its deposition.

2. *A sacculated aneurism* is one in which dilatation occurs in part of the circumference of the artery only (Fig. 70, B, C, and D). It may consist of all three coats; but much more often the internal and middle coats give way, and it is formed of only the external coat, or after it has existed some time, chiefly of condensed cellular tissue around. According as all three coats are or are not present, the aneurism was formerly spoken of as *true* or *false*. As, however, it is only the smallest aneurisms that can consist of all three coats, the true aneurism could hardly be said ever to occur, and all sacculated aneurisms were then called false—the absurdity of which is self-evident. As these aneurisms increase in size, the sac comes to consist almost entirely of the tissues around. Whilst they are still enclosed by one of the coats of the artery, they are sometimes called *circumscribed*, and after all the coats have given way, *consecutive* or *diffused* (Fig. 70, F). As the term diffused, however, is sometimes applied to a leaking or ruptured aneurism, it had better be discontinued. Nearly all sacculated aneurisms, when they have existed some time, are of the consecutive variety, and usually contain a considerable amount of laminated fibrin.

3. *A dissecting aneurism* is one in which the internal coat of the artery and part of the middle coat have given way, and the blood has been forced between the two layers of the middle coat for a variable distance parallel to the

course of the artery (Fig. 70, E). It is most frequent in the arch and thoracic portion of the aorta. The blood may remain between the layers of the middle coat, or it may escape through a rupture of the external coat into the tissues around, or through a rupture of the internal coat lower down the course of the vessel into the lumen of the artery.

TERMINATIONS.—An aneurism may terminate in spontaneous recovery or in death.

Spontaneous recovery may take place :—A. *By the gradual deposit of fibrin from the blood in a laminated manner* on the walls of the sac, so that the aneurism is completely consolidated (Fig. 72, *a*), and subsequently by condensation and shrinking becomes converted into a small nodular mass of fibrous tissue. The artery under such circumstances may remain pervious, or become converted into a fibrous cord as far as the first collateral branch above and below the seat of the aneurism. Such a favourable termination may be brought about by the retardation of the blood current induced by—(1) the lowering of the heart's action ; (2) the pressure of the aneurism on the artery above its opening into the sac (Fig. 72, *c*); (3) the *partial* blocking of the mouth of the sac with a piece of detached coagulum ; (4) the impaction of a piece of clot in the artery below the mouth of the sac (Fig. 72, *b*) ; (5) the pressure of another aneurism or of a tumour upon the artery above the sac or on the sac itself ; (6) the aneurism rupturing, and the effused blood compressing the artery leading to the aneurism. B. *By the filling of the sac with ordinary coagulum, the passive clot* as it is called, in contradistinction to the deposit of laminated fibrin (*the active clot*). This coagulation of the blood in the sac may be brought about by—(1) the *complete* blocking of the mouth of the sac by a piece of detached clot (Fig. 72, *d*), or (2) the complete plugging of the artery above and below the aneurism. The clot may then undergo the ordinary changes that occur in the so-called organization of blood-clot, and be converted into fibrous tissue. C. *By the inflammation and sloughing of the sac* and the plugging of the artery above and below with clot and the subsequent changes described under the spontaneous arrest of hæmorrhage.

A fatal termination may be brought about by—1, rupture of the sac ; 2, inflammation and sloughing of the sac attended by hæmorrhage ; 3, pressure upon important parts ; 4, gangrene due to the obstruction to the circulaion in consequence of the large size of the aneurism, or to the plugging of a large vessel by a portion of detached clot; 5, general constitutional disturbance. Rupture when it occurs into a serous cavity is generally by a rent or fissure; into a mucous canal, by a small round ulcerated opening; on to a cutaneous surface, by sloughing of the skin covering the sac. In the first case, the rupture is generally rapidly fatal from excessive hæmorrhage; in the last two, only after repeated hæmorrhages, the slough having at first a tendency to cause tho coagulation of the blood and block the opening.

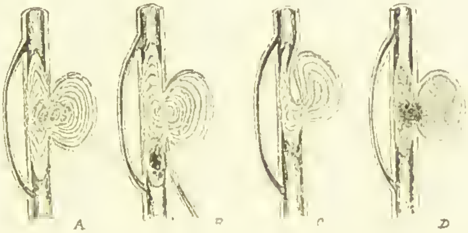


Fig. 72.—Diagram to show methods of spontaneous cure of aneurism. A. by laminated clot, B. by plugging of artery below, C. by pressure of aneurism on artery, D. by plugging of mouth of sac and formation of passive clot.

Pressure effects.—The pressure of the sac of an aneurism may cause—1, inflammation and condensation of the parts around, which thus become blended with the sac; 2, diminution or obliteration of the lumen of a large vein, and hence 3, œdema and dilatation of the superficial veins; 4, irritation or interruption of the conducting power of nerves giving rise to pain, spasm, or paralysis; 5, erosion of the bones and cartilage; 6, obstruction of the œsophagus, trachea, or thoracic duct.

Effect on the circulation.—Hypertrophy of the left ventricle of the heart, obstruction of vessels and enlargement of the anastomotic channels, syncope, and gangrene.

SYMPTOMS AND SIGNS OF EXTERNAL ANEURISM.—The attention is usually first drawn to the disease by pain, swelling, and a feeling of muscular weakness, or by stiffness in a joint. On examination a tumour is discovered in the course of the main artery. It pulsates, and tho pulsation is *expansile*, that is, on placing the hand upon the aneurism, it is felt at each systole of the heart to enlarge in every direction, or if the hands are placed on either side of the tumour, they are seen to be slightly separated at each pulsation. If the artery on the cardiac side of the tumour can be compressed, the pulsation of the tumour is felt to cease, and the tumour itself to become perceptibly smaller and less tense. On cessation of the pressure, however, it quickly fills again in two or three forcible pulsations, and resumes its former characters. On raising the limb, the pulsation is less forcible; on lowering the limb more forcible, the tumour at the same time becoming more tense. The pulse below the tumour is smaller on the affected than on the sound side, and a sphygmographic tracing, if taken, shows the pulse is delayed on the diseased side and diminished in force, the tracing being less abrupt in its rise and more rounded (Fig. 73 B). On listening with the stethoscope, a bruit is heard in most cases. In consequence of pressure on the vein corresponding to the artery, there is often œdema of the part below, and sometimes varicosity of the superficial veins.

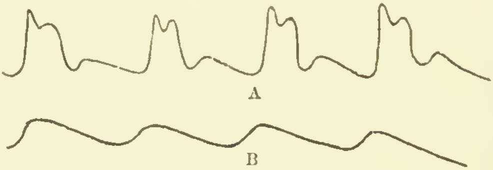


Fig. 73.—Sphygmographic tracing of the pulse in an artery below an aneurism (B) compared with that of the pulse on the sound side (A). (After Mahomed.)

In *internal aneurisms*, no tumour may be felt; the signs are then often obscure, and the diagnosis will depend upon the effects the aneurism produces by pressing upon important parts. Thus, in thoracic aneurisms, there may be pain, dyspnœa, dysphagia, cough, aphonia, dilatation of the pupil on one side, enlargement of the superficial veins, and œdema of one arm; signs readily explainable by the pressure on the nerves, trachea, bronchi, œsophagus, and arteries and veins of the thorax. But for a more detailed account of the symptoms of internal aneurism, a work on Medicine must be consulted.

The signs of an aneurism undergoing spontaneous cure are usually obvious. The tumour decreases in size, and the pulsation in it gets gradually less and finally ceases. At times a rapid cure may ensue; the pulsation then ceases suddenly, and the tumour is felt to be hard, the patient often complaining of great pain at the moment of consolidation.

The signs of a leaking aneurism, i.e., an aneurism in which blood is beginning to be slowly effused into the tissues. The pulsation is less distinct, the outline of the tumour less circumscribed, the growth progressive, and the pressure-signs are more urgent.

The signs of sudden rupture of an aneurism.—1. If the rupture is into a serous cavity, the signs are those of internal hæmorrhage, rapidly followed by death. 2. If the blood is effused into the tissues, there will be pain, faintness, loss of pulsation and bruit, rapid increase in the size of the swelling, œdema, coldness, and cessation of the pulse in the parts below, followed by increasing syncope from loss of blood, or if death does not soon occur, by gangrene. 3. Rupture externally is very rare; the signs are evident.

DIAGNOSIS.—An aneurism may have to be diagnosed from simple dilatation of an artery, an abscess or tumour over an artery, a pulsatile tumour of bone, and enlargement of the thyroid gland. In a *simple dilatation*, there is an absence of bruit. In an *abscess or tumour over an artery*, the pulsation is not expansile, there is no bruit, and the swelling is not emptied or made less tense on compressing the artery above. A *tumour* can be lifted from the vessel. In the case of an *abscess*, there will probably be a history or signs of previous inflammation. In a *tumour raising an artery over it*, the pulsation is only felt in the course of the artery, and there is no expansile pulsation in the swelling. In *pulsatile tumour of bone*, the pulsation is not equally expansile all over; and although pulsation is stopped on compressing the artery above, the swelling does not become smaller like an aneurism, or refill on removal of the pressure in two or three beats of the heart. Portions of expanded bone may also be felt in parts of the tumour, and there may be glandular enlargement and other signs of malignancy. From an *enlarged thyroid gland*, a carotid aneurism may be distinguished by the gland moving with the larynx on deglutition.

TREATMENT.—In no disease, perhaps, has an accurate knowledge of its pathology done more to ensure success in treatment than in aneurism. The older Surgeons, believing that the clot possessed vicious properties, directed their efforts to the emptying of the sac; and it was not until the fact became fully recognized that Nature's method of curing an aneurism was by filling the sac with organizable clot, that the lamentable results attending the treatment of aneurism in olden times gave place to the brilliant successes of modern surgery. Our treatment at the present day is therefore directed rather to aiding or promoting Nature's efforts than to thwarting them. Thus, the modern Surgeon, by means of rest, low diet, recumbency, and certain medicines, endeavours to lessen the force of the blood-current through the sac, and thus to aid Nature in the deposition of laminated fibrin. By compression or ligature of the artery between the aneurism and the heart he aims at diminishing the flow of blood through the artery leading to the aneurism, and in this manner seeks a like result. By *manipulation* and the use of the *distal ligature*, he endeavours to copy the method of spontaneous cure that is sometimes brought about by the plugging of the artery beyond the aneurism; whilst by *flexion*, he imitates Nature's method of cure by the pressure of the aneurism itself on the artery either above or below the sac. The treatment of aneurism, therefore, may be divided into the medical or general, and the surgical or local.

Medical treatment.—Both internal and external aneurisms have been cured by medical treatment alone. Indeed, in some forms of internal aneurism, it is the only means at our command. In external aneurisms, however, local treatment in addition is nearly always expedient or necessary. Absolute rest, both bodily and mental, should be enjoined; the patient must lie in bed, and must not move for any purpose whatever, not even to feed himself. The diet should be limited in quantity, unstimulating but nutritious in quality, and the fluid portion restricted as much as possible. Tho following diet scale is advised by Mr. Jolliffe Tufnell:—Bread and butter, 4 ozs.; meat, 3 ozs.; potatoes, 3 ozs.; fluid, 8 ozs. in the twenty-four hours. Small repeated bleedings, where there is excessive action of the heart, or the patient is plethoric, may occasionally be useful. Medicines seem to have little efficacy, but iodide of potassium in large doses, acetate of lead, aconite, and digitalis have been recommended, either for promoting tho coagulation of tho blood, or retarding the heart's action. Where there is a history of syphilis, iodide of potassium should certainly be given.

Surgical treatment.—In all suitable cases of external aneurism pressure, when it can be applied between the aneurism and the heart, should first be tried, aided under certain circumstances by the method of flexion. But these failing, or appearing unsuitable, the artery should be tied, if practicable, on the proximal side, and preferably at some distance from the sac where the artery is more likely to be healthy. Where pressure or ligature cannot be used on the proximal side, as for instance, in aneurisms at the root of the neck, it becomes a question whether we should try distal pressure or ligature, manipulation, galvano-puncture, coagulating injections, or the introduction of wire or horsehair; or fall back on medical means alone. In some varieties of traumatic aneurisms where the artery is presumed to be healthy, and in certain forms of aneurism, as gluteal, where a ligature of the artery at a distance from the sac is attended with excessive risk, it may even be expedient to resort to the old method of opening the sac, turning out the clot, and securing both ends of the bleeding vessel by ligature. Each of these methods requires discussion. Before resorting to surgical methods, however, the circulation through the aneurism should have been previously quieted as much as possible by rest, recumbency, restriction of the diet, and regulation of the secretions. Where the aneurism is on an artery of the lower extremity, any embarrassment of the venous circulation and consequent œdema that may be present, should be lessened or removed by elevating and lightly bandaging the part.

Pressure.—This method of treating aneurism was known to the older Surgeons, but in consequence of their efforts being directed either to the emptying of the sac by direct pressure upon it, or to the obliteration of the artery leading to it by adhesive inflammation, it was attended with such unfavourable results that it fell into disuse. To the Dublin Surgeons, who recognized the fact that it was not necessary to obliterate the artery in order to cause consolidation of the aneurism, is due in chief part the credit of reviving treatment by pressure. The object of pressure as now employed, is to produce consolidation of the aneurism, by the formation of either a laminated, or an ordinary coagulum. The methods of bringing this about may be considered under 1, direct pressure on the aneurism; and 2, indirect pressure, either on the artery above, on the artery below, or on both simultaneously.

1. *Direct pressure* is now seldom used, except in as far as flexion may be considered as in part a method of direct pressure, although several successful cases have of late been reported. It will not receive further notice.

2. *Indirect pressure*, whether applied to the artery above, the artery below, or to both at the same time, may be considered under the heads of—(*a.*) Digital pressure. (*b.*) Instrumental pressure. (*c.*) Pressure by Esmarch's bandage. (*d.*) Pressure by flexion of the limb.

(*a.*) *Digital pressure*, where it can be applied to the artery on the proximal side at some distance from the sac, is undoubtedly the safest and best method of treating an aneurism; and is the one, other things being equal, which should usually first be tried. Its advantages are—1, that it causes less pain than other forms of pressure; 2, that the artery can be compressed with little or no interference with the venous circulation; 3, that it is less liable to injure the tissues; and 4, that in common with other methods of pressure, it does not expose the patient to the dangers of an open wound. It requires a relay of intelligent assistants acting in pairs and alternately compressing the artery for about ten minutes at a time. Whilst one presses the artery, the other should have his hand on the aneurism, to ascertain if pulsation is being properly controlled. The fingers of the one assistant should not be removed till the other has taken his place, as the artery must on no account escape compression for a single moment. The pressure of the fingers may be aided by a shot-bag, and the spot at which pressure is applied may be slightly varied from time to time. Opinions differ as to whether the circulation should be completely, or only partially stopped through the artery, and whether the pressure should be continued both day and night, or only during the day. Aneurisms have been cured by digital pressure in a few hours, but some days are usually necessary; and to obtain success, much care and attention to detail is required.

(*b.*) *Instrumental pressure* may be applied so as only partially to control the circulation through the artery, and thus induce the gradual obliteration of the aneurism by the deposit of laminated fibrin in the sac (*slow pressure*); or it may be applied so as to completely control the flow of blood through the vessel, and induce rapid coagulation in the sac (*rapid pressure*). The latter method can only be done under an anæsthetic, but has been attended with some brilliant results, especially in cases of abdominal aneurisms. As a rule for external aneurisms, however, the milder measures will suffice, and it is a question if these fail whether it is not better treatment to ligature the artery than subject the patient to further attempts at cure by rapid pressure. Both kinds of pressure may be applied by one or other of the many forms of compressors and tourniquets which have been invented for the purpose (Figs. 74, 75, and 76). It is better when possible to apply the pressure to one artery, though slightly varying its position, than to change from one artery to another, as from the superficial to the common femoral, since by so doing different sets of anastomosing arteries are enlarged, and the collateral circulation may become too free.

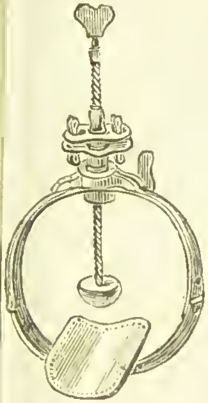


Fig. 74.—De Carte's Tourniquet.

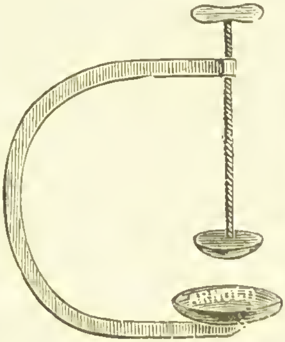


Fig. 75.—Lister's abdominal Tourniquet.

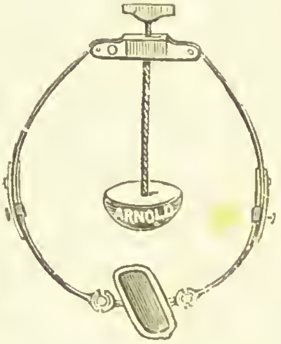


Fig. 76.—Skey's Tourniquet.

Cases unsuitable for pressure.—1. Where the aneurism is of very large size, or is rapidly increasing. 2. Where the sac is thin, contains but little fibrin, and appears likely soon to burst. 3. Where there is much œdema from venous obstruction. 4. Where the patient is of an irritable disposition, is intolerant of pain, or has been addicted to the abuse of alcohol. It is considered by some that even if pressure fails good may have been done by causing a deposit of fibrin in the sac, and by enlarging the collateral vessels. By others these advantages are thought to be outweighed by the irritation and disappointment to the patient of failure, and the bruising and injury of the tissues at the situation where the artery will have to be tied.

(*c.*) *Pressure by Esmarch's bandage* (*Reid's method*) aims at simultaneously compressing the artery above and below the aneurism, and causing the blood contained in both the aneurism and the artery to coagulate. The elastic bandage, in the case of popliteal aneurism in which this method of compression has most often been used, should be evenly applied from the foot as far as the aneurism; a turn should be then made over the tumour, so as only lightly, if at all, to compress the sac, and the bandaging then continued firmly half-way up the thigh. The bandage should be kept on for an hour to an hour and a half. The elastic cord should not be used at all. On removing the bandage digital pressure should be kept up on the main artery from thirty-six to forty-eight hours, so as to control the circulation and prevent the clot, while still soft, from being washed out of the artery and sac. The patient must be placed under an anæsthetic during the use of the bandage, as it causes great pain. Many cases have been cured by this method; but on the other hand there have been many failures, and it is far from being unattended with danger. Thus, gangrene of the limb and rupture of the sac have ensued, and aneurisms of internal arteries have apparently been produced by the prolonged increase of blood-pressure in the rest of the arterial system.

(*d.*) *Pressure by flexion* (*Hart's method*) consists in flexing the limb so as to compress the artery by the aneurism in imitation of that form of spontaneous cure which is brought about by the pressure of the aneurism itself on the artery above and below. It is obviously applicable to aneurisms in but very few situations, and has been most successful in those of the popliteal artery. It may be used either alone, or in conjunction with digital or other pressure, or with medical treatment.

LIGATURE, like pressure, is a very old method of treatment, but to Anel and John Hunter is due the credit of having placed it on a scientific basis. The older Surgeons laid open the sac and turned out the clots, and endeavoured to staunch the hæmorrhage by ligaturing the artery above and below the aneurism. Antyllus, however, applied his ligatures before opening the sac; but it was not until centuries afterwards that Anel recognised the fact that it was unnecessary to open the sac at all, and tied the artery immediately above the aneurism. Many years later Hunter perceived that the complete stoppage of the circulation obtained by Anel's method was not necessary, and that the ligature of the artery close to the sac was attended with the risk of hæmorrhage and inflammation. He therefore applied his ligature at a distance from the aneurism, where he had observed moreover that the artery was likely to be in a healthier condition. For aneurisms so situated that a ligature cannot be placed on the cardiac side, Brasdor proposed tying the trunk of the artery on the distal side of the aneurism; whilst Wardrop suggested tying one or two of the terminal branches of the artery on the distal side of the aneurism where neither Brasdor's operation nor the proximal ligature was applicable. Hence ligature for aneurism may be applied (Fig. 77), 1. ON THE PROXIMAL SIDE of the aneurism either at a distance (*Hunter's method*) or immediately above it (*Anel's method*). 2. ON THE DISTAL SIDE of the aneurism, either to the main trunk (*Brasdor's method*), or to one or more of the main branches (*Wardrop's method*). 3. IMMEDIATELY ABOVE AND BELOW the aneurism, either opening the sac (*the old operation*), or without opening the sac (*Antyllus's method*).

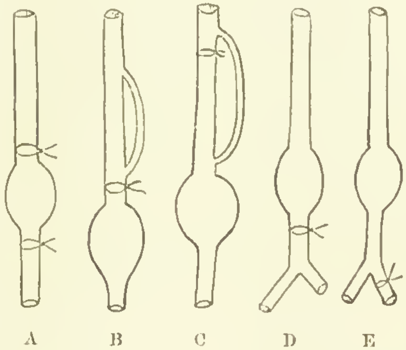


FIG. 77.—Different positions of ligature for Aneurism.
A. Antyllus's method; B. Anel's; C. Hunter's; D. Brasdor's; and E. Wardrop's.

1. THE PROXIMAL LIGATURE. A. HUNTER'S METHOD.—

This operation, when applicable, is the one now almost universally adopted. Its chief merits are—1. That the artery selected for ligature is not only more likely to be healthy, but is also more easily tied than the artery in close proximity to the sac, in which situation, moreover, its anatomical relations are liable to be disturbed by the aneurism. 2. That the sac is not interfered with, and hence is less likely to become inflamed and suppurate; and 3. That as several branches will probably be given off between the ligature and the aneurism the circulation through the sac, though lessened, will not be completely arrested, and the clot is therefore more likely to have a laminated, and hence a permanent, character.

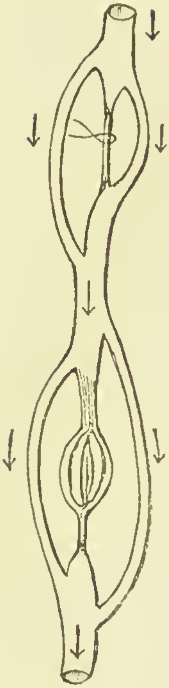


FIG. 78.—Diagram to show the condition of the artery and aneurism after the Hunterian ligature, and the establishment of the collateral circulation. The arrows indicate the direction of the blood current.

Effects of the proximal ligature.—After the successful application of a ligature by the Hunterian method the pulsation in the aneurism immediately ceases, and for a time the circulation through the limb is diminished. Hence the temperature becomes lower and the surface pale. Soon, however, the collateral circulation becomes established, and a faint pulsation may be felt again in the aneurism; but this recurrent pulsation grows less from day to day, and shortly ceases, and the aneurism slowly shrinks and is finally absorbed, or remains as a small, hard, fibrous mass. The artery leading to the aneurism may remain pervious, but it more frequently becomes obliterated as far as the first collateral branch above and below the sac. The artery on either side of the ligature also becomes obliterated as far as the first collateral branch. This condition of an aneurism and artery after ligature is seen in the accompanying woodcut (Fig. 78). The blood passes the ligature by the collateral channels; re-enters the artery below; passes the obstruction where the artery is closed at the seat of the aneurism, also by collateral channels; and then again enters the main artery.

Treatment after ligature.—The limb should be completely swathed in the cotton-wool and flannel bandages (which, before the operation, should have already been carried up as far as the seat of the ligature), and kept at perfect rest. In the case of popliteal aneurism, the limb should be slightly raised on a pillow, and placed on its outer side, with the knee a little flexed. If the weather is at all cold, hot bottles should be applied, near, but not in contact with, the limb, care being takon that no pressure is made on the heel, malleoli, or other points of bone, for fear of local sloughing. The patient must be kept in bed till the aneurism is thoroughly consolidated, and the operation wound has healed.

THE DANGERS OF LIGATURE.—These are—(*a*) secondary hæmorrhage; (*b*) gangrene; (*c*) recurrent pulsation; (*d*) suppuration and sloughing of tho sac; (*e*) phlebitis; (*f*) great enlargement of the aneurism without pulsation; and (*g*) the other dangers that may attend any cutting operation.

(*a*.) *Secondary hæmorrhage* is liable to occur at any period before the wound is soundly healed. The causes, symptoms, and treatment, are discussed under "Hæmorrhage," see p. 124.

(*b*.) *Gangrene* is more common in the leg than in the arm; indeed, in the latter situation it is very rare. It may be due to—1, failure of establishment of the collateral circulation, when it usually supervenes within a few days; or 2, venous obstruction, the result of plugging of the vein in consequence either of injury at the time of operation, or of pressure on the vein by a swollen and suppurating sac. When due to the latter conditions, it may be delayed for some weeks. When extensive and spreading rapidly, amputation at the seat of ligature must be performed. The surgeon, however, should not be in too much haste to amputate, as the gangrene may involve only a toe or two, or part of the foot, and spread no further. When, therefore, it is limited in extent, and spreading slowly, a line of demarcation should be waited for before amputation is performed. When the sac is very large, and the gangrene appears due to pressure on the vein, the sac may at times be opened with advantage, the clots turned out, and any bleeding vessels secured.

(*c.*) *Recurrent pulsation*, when slight, is a good sign, as it shows that the collateral circulation is becoming established, and, consequently, that the danger of gangrene is lessened, if not passed. If, however, instead of ceasing, as it usually does in a few days, it becomes more pronounced, the limb should be raised, and carefully bandaged from the foot upwards, and pressure applied to the artery leading to the sac. If this does not suffice, and the pulsation returns as strongly as ever, and the aneurism again begins to increase in size, it is clear that the ligature has failed; and it becomes a grave question what further treatment should be undertaken. Should it appear that a large branch is feeding the aneurism, this should undoubtedly be secured; otherwise the choice will probably lie between—1, pressure upon the artery and aneurism; 2, the use of Esmarch's bandage; 3, flexion in the case of a popliteal aneurism; or if these fail, 4, tying the vessel either above the aneurism, or above the former ligature; 5, cutting down upon the sac, and securing both ends of the artery; or 6, amputation. Much will turn on each individual case, and the discussion as to a choice of method is too long to be entered upon here.

(*d.*) *Inflammation and suppuration of the sac* may be met with after pressure, as well as after ligature; and although it may occur after the Hunterian operation, is more frequent in cases where the ligature has been applied close to the sac, or where rapid pressure has been used. It appears to be due to—1, the spread of inflammation to the sac from the wound; 2, the formation in the sac of a soft coagulum; or 3, excessive manipulation before the operation. It is ushered in with redness, heat, pain, and swelling of the sac (which has not undergone the usual process of shrinking), and œdema of the surrounding parts. Later the skin gives way, and a mixture of pus and broken-down coagula escapes. It may be accompanied by hæmorrhage; but more commonly the vessel has become sealed and no bleeding occurs. The abscess should be opened as soon as pus has formed, previously inserting a grooved needle if in doubt on this point. Should hæmorrhage occur, the clots must be turned out, and the artery secured above and below, or amputation performed.

(*e.*) *Phlebitis* may occur from injury to the vein in passing the aneurism needle. Should the vein be pricked, an accident which may be known by venous blood welling up by the side of the ligature, the artery should on no account be tied at this spot, as the ligature would act as a seton in the vein, and death possibly ensue from phlebitis or pyæmia. The ligature, if already passed, should be withdrawn, pressure applied to the vein, and the artery tied higher up. Where this treatment has been adopted, I have never seen any ill results follow the injury.

B. Anel's operation is seldom done except where the Hunterian method is inapplicable, as for aneurism in the groin, aneurism of the upper part of the common carotid, &c. Its disadvantages are—1, that the artery is likely to be diseased; 2, that its anatomical relations are apt to be disturbed by the contiguity of the sac; 3, that the sac itself is liable to be injured during the operation, and to become inflamed and suppurate; and 4, that the clot which forms in the sac is of the soft or passive variety.

2. The distal ligature should only be used where the Hunterian or Anel's method cannot be applied. *Brasdor's method*, which consists in securing the main trunk on the distal side of the aneurism, may be employed in aneurism of the carotid at the root of the neck. It copies that method of spontaneous cure in which a clot blocks the artery beyond the aneurism. After the ligature the clot that forms in the artery may extend to the aneurism, which thus becomes filled by a coagulum; or the blood-pressure in the sac may become so diminished that laminated fibrin is deposited. Unfortunately, however, in practice the blood-pressure in the aneurism appears in some cases to be increased rather than diminished. *Wardrop's method* consists in securing two or more of the main branches of the artery on the distal side of the aneurism. It aims at cutting off part of the blood-stream through the aneurism, and so, by reducing the blood-pressure, promoting the deposition of laminated coagulum. It has been applied to the subclavian and carotid arteries for aneurism of the innominate; but the success attending it has not been great. The chief risks are passive enlargement and subsequent bursting of the sac, or inflammation and suppuration of the sac.

3. The double ligature.—Ligature above and below the sac, either, 1, by the old method of first laying the sac open and then securing the bleeding ends of the artery; or, 2, by the method of Antyllus, of first securing

the artery and then laying the sac open, is only employed in exceptional cases. Thus *the old method* is sometimes resorted to in traumatic aneurism of the axillary artery in preference to tying the subclavian, and also in gluteal aneurism where the Hunterian method of tying the common or internal iliac is attended with such terrible risk. The great danger is the patient dying under the operation of hæmorrhage. During the operation, therefore, in the case of the axillary artery pressure should be made on the subclavian, an incision through the skin and fascia above the clavicle being made to ensure its better control. In the case of the gluteal, Davy's lever or the abdominal tourniquet should be used. The true *method of Antyllus* may, in rare instances, be required as in some forms of aneurism at the bend of the elbow.

MANIPULATION.—A spontaneous cure, as we have seen (p. 272), is sometimes brought about by the impaction of a portion of clot either in the mouth of the sac or in the artery below. Manipulation of the sac aims at breaking up and displacing the clot in the hope that a portion may become impacted in this way, and so lead to consolidation. Sir William Fergusson, who first introduced this method, used it with success, and others have done so likewise. It is far from being unattended with danger, however, since a portion of the clot may be carried away by the blood-stream and become lodged in a vessel leading to an important organ, as the brain. It should, therefore, only be tried when other means are impracticable or appear attended with even greater risk.

GALVANO-PUNCTURE, INJECTIONS OF PERCHLORIDE OF IRON, TANNIN, and the like, and the INTRODUCTION of FOREIGN BODIES AS HORSEHAIR or IRON WIRE, which have all for their object the coagulation of the blood in the sac, have not hitherto been attended with much success.

SPECIAL ANEURISMS.

INTERNAL ANEURISMS falling as they do under the care of the physician rather than of the surgeon, will be referred to only in as far as an aneurism of the arch of the aorta, of the innominate, of the first portion of the subclavian, and of the portion of the common carotid within the chest may present as a pulsating tumour at the root of the neck, and as such may call for surgical treatment.

Aneurism at the root of the neck.—The differential diagnosis of aneurism in this situation is always difficult, at times impossible. Indeed the aneurism may involve more than one artery, perhaps all three of the main branches of the aortic arch, and even the arch itself as well. The sign common to all forms, whatever the artery implicated, is a pulsating tumour at the root of the neck, in which a loud bruit can generally be heard. When the aneurism involves the *aorta*, it generally presents just above the suprasternal notch, and there are symptoms within the chest of the aorta being affected. When the *innominate* is implicated, the aneurism projects between the two heads of origin of the sterno-mastoid muscle; and the pulse in the temporal and radial arteries is smaller on the right than on the left side, and is aneurismal in character. (See p. 274.) When the aneurism involves the *common carotid*, it presents beneath the inner head of the sterno-mastoid, and tends to extend upwards in the neck by the side of the trachea; the bruit is transmitted up the carotid, and the pulse in the temporal is smaller on the affected than on the sound side and is aneurismal; but the pulse in the radial is the same on both sides. When the *subclavian* is involved the tumour is external to the sterno-mastoid; it extends in the direction of the subclavian artery; the bruit is transmitted towards the axilla; and the pulse at the wrist is diminished in volume and is aneurismal. Such is a brief outline of the differential diagnosis of these aneurisms; but there are many other signs due to the pressure of the aneurism on the veins, nerves, œsophagus, trachea, &c., which have to be taken into account, and which it is evident the size of this work does not permit to be discussed. *Treatment.*—When the aneurism is aortic medical means alone must be relied on. When the innominate is involved, medical means and pressure on the carotid failing, distal ligature of the carotid and subclavian arteries simultaneously may be tried. This not proving successful or being impracticable owing to the large size of the aneurism, nothing is left but the desperate resort to galvano-puncture or the introduction of iron wire. When the carotid or subclavian is affected medical means must also in the first instance have due trial; afterwards, in the case of the carotid, distal compression or ligature may be tried; and in the case of the subclavian distal compression or ligature if practicable, direct pressure on the sac, or the terrible expedients of amputation at the shoulder-joint, ligature of the innominate, manipulation. galvano-puncture, injection of coagulents, and introduction of iron wire.

Carotid aneurism at the root of the neck has just been alluded to. Aneurism of the common trunk higher in the neck presents the ordinary signs of aneurism, and in this situation has to be diagnosed from—1, simple dilatation of the artery at its bifurcation; 2, enlarged glands; 3, abscess or tumour over the artery; 4, pulsating goître. In simple dilatation there is no bruit; in enlarged glands and tumours there is also no bruit, the pulsation is not expansile, and ceases when they are lifted up from the vessel; in abscess, in addition to the absence of the above signs, there is the history or presence of inflammation; in pulsating goître the tumour moves up and down with the larynx on deglutition. The *treatment* consists in pressure or ligature of the artery below the aneurism, or if there is not room in this situation, distal ligature.

Aneurism of the external and internal carotids require no special mention. Pressure or ligature of the common carotid is the treatment generally indicated.

Orbital aneurism.—Several conditions may give rise to the group of symptoms to which the name "orbital aneurism" has been applied. In only one instance has the existence of a circumscribed aneurism in the orbit been verified by an autopsy. In the other cases that have proved fatal the following conditions were found:—1. Thrombosis of the cavernous sinus. 2. Communication between the carotid artery and cavernous sinus. 3. Dilatation of the carotid artery. 4. Aneurism of the ophthalmic artery *within* the cranium. The *general symptoms* are:—pulsation over the whole or part of the orbit; protrusion of the eyeball with loss or impairment of sight; more or less pain; and a loud bruit which can often be heard also by the patient. The differential diagnosis of the several conditions producing these symptoms is one of great difficulty and cannot be entered upon here. *Treatment.*—The symptoms have been known to subside spontaneously. Where they have not done so ligature of the carotid has been attended with the best results. Injection of perchloride of iron has been recommended, but I should hesitate to use it myself for fear of venous thrombosis and embolism. Where the pulsation has followed a punctured wound of the orbit it has been advised to extirpate the globe and secure the bleeding vessel in the orbit. In a case of the kind recently under the care of my colleague, Mr. Power, ligature of the common carotid was attended with the most perfect success.

AXILLARY ANEURISM is not uncommon as the result of sprains, or of attempts to reduce long-standing dislocations of the shoulder. The *diagnosis*, as a rule, presents no difficulty except the aneurism has become diffused, when it may be mistaken for abscess. *Treatment.*—1. When the aneurism is spontaneous, small, and well-circumscribed, pressure or ligature of the third part of the subclavian should be practised. 2. When more or less diffused, as when the result of an injury to the artery in the reduction of a dislocation, the aneurism should be cut down upon, the clots turned out, and the vessel secured above and below. If this operation is decided on, an incision should be made over the subclavian artery through the skin and fascia, so that pressure may be made on it more directly, and the circulation through the aneurism during the subsequent operation better controlled. A small incision is then made over the aneurism, two fingers are introduced into it, and placed on the bleeding spot in the artery, which may be known by the hot arterial blood issuing from it. An assistant in the meantime enlarges the wound, turns out the clots, and helps the Surgeon to tie the artery above and below the rupture before the fingers are removed. This method is less dangerous than that practised by Syme, who made a free incision over the aneurism, rapidly turned out the clots, and seized with forceps the bleeding point in the artery. 3. Where the aneurism is of great size and involves the subclavian, the first part of the subclavian or the innominate may be ligatured, or iron wire introduced, galvano-puncture or manipulation tried, or amputation at the shoulder-joint performed. Space does not permit of a discussion of the cases in which one or other of these methods is the more suitable. All, however, are desperate expedients.

ANEURISMS AT THE BEND OF THE ELBOW were formerly common when venesection was in vogue, and were then generally arterio-venous in character (see p. 192).

GLUTEAL ANEURISM is the term applied to aneurism of the gluteal artery itself, the sciatic, or the pudic where it winds over the spine of the ischium. Aneurisms in this situation may be the result of a wound or other injury, or occur spontaneously. They are frequently attended with pain and interference with the movements of the hip-joint. The pulsation and bruit will generally serve to distinguish them, but there may be no pulsation, as where the aneurism has burst, or blood has been effused into the tissues as the result of a wound of the artery; a tumour of bone, moreover, may also pulsate. Under such circumstances, exploration with a grooved needle will be necessary. *Treatment.*—When of traumatic origin, an incision should be made over the tumour, the clots turned out, and the bleeding vessel secured, the hæmorrhage during the operation being controlled by pressure on the common iliac by Davy's lever or by the hand in the rectum. When spontaneous, the internal iliac may have to be tied if the aneurism encroaches on that vessel within the pelvis—a point which may perhaps be determined by exploring with the hand in the rectum. Before, however, resorting to ligature of the internal iliac, compression of the abdominal aorta or common iliac, and carefully applied direct pressure on the swelling, should be tried. Galvano-puncture and the introduction of coagulants have been employed successfully in this aneurism.

INGUINAL ANEURISMS are those which involve either the termination of the external iliac, or the commencement of the femoral. They may extend either upwards along the course of the iliac into the abdomen, or downwards in the course of the femoral into the thigh. They may have to be diagnosed from enlarged inguinal glands over the artery, tumours, especially pulsating tumours of the pelvic bones, and abscesses. From abscess and tumour they may be distinguished by the signs already several times alluded to. Their diagnosis from pulsating tumours of bone is often very difficult, and the external iliac has before now been tied by the most skilful Surgeons under the impression that such a tumour was an aneurism. The diagnostic points have already been given under pulsatile tumours of bone and diagnosis of aneurism (pp. 230, 275). *Treatment.*—1. When the aneurism is of moderate dimensions, and involves only a small portion of the external iliac, this vessel should be tied, or if preferred, an attempt may first be made to apply compression to it. 2. Where there is apparently not room to apply a ligature to the vessel, rapid compression of the abdominal aorta may be employed, combined in some cases with distal pressure. 3. Where there is not room for the tourniquet on the aorta, medical means must be relied on, or the desperate expedient resorted to of tying the common iliac or aorta, or injecting coagulants, or passing iron wire into the sac.

FEMORAL ANEURISM requires no special remark other than when situated in Hunter's canal, the femoral should be compressed or tied in Scarpa's triangle. When situated in Scarpa's triangle, the external iliac may be treated in the same way. In either case Esmarch's bandage may be used if this method of treatment commends itself to the Surgeon's judgment.

POPLITEAL ANEURISM.—The frequency of aneurism in this situation is attributed to—1, the bifurcation of the popliteal artery into the anterior and posterior tibial, whereby the circulation through it may be slightly obstructed, or an embolus be readily impacted; 2, the artery being unsupported by muscles, and in contact with the bone; 3, the strain on the artery in the movements of the knee-joint; 4, the compression that may be exerted on the end of the artery by the strong fascia of the soleus muscle. The diagnosis of popliteal aneurism is not usually difficult; but should it become diffused, suppurate, or break into the knee-joint, it may be mistaken for a malignant tumour of the bones, an abscess, or an affection of the joint. The history of the case, the consideration of the diagnostic signs of aneurism already given, and the introduction of a grooved needle into the knee where blood has been effused into the joint, will usually clear up any doubt as to the nature of the affection. *Treatment.*—Little need be added here to what has already been said on the general treatment of aneurism, as such especially applies to aneurism in this situation. Flexion, combined with appropriate medical treatment, is often successful; and digital and instrumental compression are especially applicable to this aneurism, or an Esmarch's bandage may be used if preferred. These methods failing, or not being considered advisable, the femoral artery should be tied in Scarpa's triangle, an operation which should be done at once under the following circumstances:—1. When the aneurism is rapidly increasing in size, leaking, or threatening to burst. 2. When the aneurism is inflamed but has not suppurated. 3. Under some circumstances when it has burst into the knee-joint. 4. When the limb is œdematous, showing that the vein is being seriously compressed. 5. When the patient is of an irritable disposition, addicted to alcohol, and impatient of control. Amputation, on the other hand, is, as a rule, called for—1, if the aneurism has burst; 2, if gangrene has set in; 3, if suppuration attended with profuse hæmorrhage has occurred; and 4, if the knee-joint is disorganized.

LIGATURE OF ARTERIES.

The ligature of arteries requires a knowledge of their relational anatomy and of the position and appearance of the various structures which serve as guides to them. Such a knowledge can only be gained in the dissecting-room, and by the frequent practice of operations on the dead body. Here only the chief rules that should guide us in applying a ligature, and a short account of the methods of tying the more important arteries, can be given.

General rules for ligature:—1. The incisions should generally be made parallel to the course of the artery, and the skin divided evenly to promote union by first intention. 2. Each successive cut through the underlying tissues should be made the same length as that through the skin, and bruising of the parts avoided as much as possible. 3. The sheaths of muscles and tendons should not, if possible, be opened. 4. The sheath of the vessel having been exposed and the artery felt pulsating with the index finger, the sheath should be pinched up with forceps and opened by cutting with the blade of the knife on the flat. 5. The sheath being opened, it must be separated from the artery in the whole of its circumference, either by careful dissection with the knife turned with its edge from the artery, or by the director insinuated by a gentle to and fro movement between the sheath and the artery. If this part of the operation is not done very delicately, too much of the sheath in the long axis of the artery will be separated, and there will be danger of secondary hæmorrhage from cutting off of the blood supply which the vessel receives from its sheath. 6. Having separated the sheath, one side of it should be seized with the forceps and the needle passed, unthreaded, between it and the artery, and the point, by a gentle to and fro movement, carried round the vessel without injuring or including any of the contiguous structures. It should always be passed from the side on which the vein lies. 7. When the point of the needle projects on the opposite side, it should be cleared from any loose cellular tissue of the sheath it may have carried before it by scratching with the finger-nail, or cutting on the needle with the edge of the scalpel directed from the artery. 8. The artery should be gently pressed between the curve of the needle and the finger to ascertain that no other structure is included, and that pressure controls the pulsation in the aneurism. 9. The needle should now be threaded with the ligature which is carried round the artery as the needle is withdrawn; the ligature should then be tied in a reef knot. 10. Should much of the sheath have been unavoidably separated from the artery, two ligatures had better be passed, and the artery divided between them. I question if this will not always be found the safer method; it is now the one generally used by several of the surgeons at St. Bartholomew's. 11. Some form of antiseptic ligature should be used, as carbolized silk, chromicized catgut, ox-aorta, or kangaroo-tail tendon, but the best material can hardly be said to have been determined. I have always used kangaroo-tail tendon myself, and have found it answer admirably. Formerly, when ordinary silk ligature was used, one end of the ligature was left out of the wound by which the ligature might be removed when it had cut its way through the vessel. Now however when an aseptic ligature is used both ends should be cut short, as the ligature will become absorbed, organized or encysted. 12. The wound should be accurately united, drained if deep, and dressed antiseptically.

LIGATURE OF SPECIAL ARTERIES.—THE COMMON CAROTID ARTERY may require tying for—1. Wound of tho artery; 2, a punctured wound near the angle of the jaw or tonsil; 3, aneurism of the upper part of the artery or of one of its branches; 4, orbital, intracranial and cirsoid aneurism; and 5, aneurism at the root of the neck (distal ligature). The artery may be tied either above or below the omo-hyoid. When practicable it should be tied above, as it is here more superficial, and the risk of suppuration extending beneath the deep fascia into the chest is avoided. *The high operation*, or ligature above the omo-hyoid. Make an incision three inches in length with its centre opposite the cricoid cartilage, along the anterior edge of the sterno-mastoid muscle, *i.e.*, in a line drawn from the sterno-clavicular articulation to a point midway between the angle of jaw and the mastoid process (Fig. 213, i). Divide the skin, superficial fascia, platysma and deep fascia. Draw the anterior edge of the sterno-mastoid gently outwards, and the artery will be felt pulsating in the angle formed by the omo-hyoid with the sterno-mastoid. Open the sheath on its inner side, and pass the aneurism-needle from without inwards to avoid injuring the vein which slightly overlaps the artery on its outer side, and keep its point close to the vessel lest the pneumo-gastric nerve be included in the ligature. The small descendens noni nerve runs superficial to the sheath, and if seen, should be avoided. The superior thyroid, lingual and facial veins cross the artery to open into the internal jugular vein. Should they impede the operation, divide them, having first applied two ligatures. *The low operation*, or ligature below the omo-hyoid. Make an incision in the same line as for the high operation but lower in the neck. Draw the sterno-mastoid outwards and the sterno-hyoid and thyroid inwards and the artery will be felt beating in the angle formed by the omo-hyoid with the sterno-thyroid. Pass the needle as before from without inwards, taking especial care not to injure the vein which on the left side slightly overlaps the artery. The head should be kept fixed after ligature by some form of splint. The *chief dangers* after ligature are—1. Cerebral mischief from partial cutting off of the blood supply to the brain; 2, a low form of pneumonia from interference with the blood supply of the pneumo-gastric centre; 3, suppuration descending into the mediastinum; and 4, suppuration of the sac when tied for aneurism. The *collateral circulation* (Fig. 79) is carried on by the anastomosis of—1. The vertebral with opposite vertebral. 2. The inferior with the superior thyroid. 3. The internal carotid with the opposite internal carotid through the circle of Willis. 4. The deep cervical with the princeps cervicis. 5. Branches of the external carotid with the corresponding branches of opposite side across the middle line of the neck.

THE EXTERNAL AND INTERNAL CAROTID ARTERIES may be tied by an incision similar to that for the common carotid, but higher in the neck. A point to remember is that the internal carotid is in position at first external to the external carotid and of larger size.

THE LINGUAL ARTERY may require ligature for hæmorrhage in cancer of the tongue, and as a preliminary to excision of the tongue. Make an incision along the greater cornu of the hyoid bone (Fig. 213, g), divide the skin, superficial fascia and platysma, hook up the submaxillary gland, and a few touches of the director will expose the triangle bounded below by the anterior and posterior belly of the digastricus, and above by the hypoglossal nerve. Scratch cautiously through the muscular fibres of the hyo-glossus which forms the floor of this triangle, taking care not to injure the lingual vein which is superficial to the muscle; the lingual artery will be seen or felt lying upon the middle constrictor of the pharynx. The vessel, however, is often abnormal, and consequently may not be found in the usual situation.

THE FACIAL ARTERY is readily tied at the anterior edge of the masseter, where it can be felt beating. It lies anterior to its vein.

THE SUPERIOR THYROID ARTERY can seldom require tying except for wounds of the neck as "cut throat," and as a preliminary to removal of the thyroid body.

THE TEMPORAL ARTERY may require ligature for cirsoid aneurisms or a wound of the vessel. It can be readily secured at the spot where it is felt beating as it crosses the zygoma just in front of the external auditory meatus (Fig. 213, h, p. 582).

THE SUBCLAVIAN ARTERY may be tied in the *third part of its course* for—1, axillary aneurism; 2, aneurism at the root of the neck (distal ligature); 3, ruptured axillary artery; 4, secondary hæmorrhage after amputation at the shoulder-joint; and 5, as a preliminary to the latter operation. The head having been drawn well back, the face turned to the opposite side and the shoulder depressed, draw down the skin over the clavicle, make an incision along the middle third of that bone through the integuments and platysma, so as to avoid injuring the external jugular vein, and let the tissues slip up again (Fig. 213, f). Next divide the deep fascia on a director, and the posterior edge of the sterno-mastoid will be exposed. Hold aside or divide if necessary the external jugular or any other vein that may be in the way, but do not injure the suprascapular artery, as this is one of the chief vessels by which the collateral circulation will subsequently be carried on. Search with the finger and director for the scalene tubercle in the triangle bounded by the omo-hyoid above, the clavicle below, and the scalenus anticus on the inner side; the artery will be felt pulsating behind the tubercle. It has the vein in front of it, but on a lower plane, and the brachial plexus above it. Pass the needle from above downwards. The artery, if necessary, may be tied in *the second part of its course* by extending the incision inwards and partially dividing the scalenus anticus. Ligature of *the first part* has been so uniformly fatal hitherto that it will not be described. The *principal accidents* that may occur during ligature in the third part of its course are—

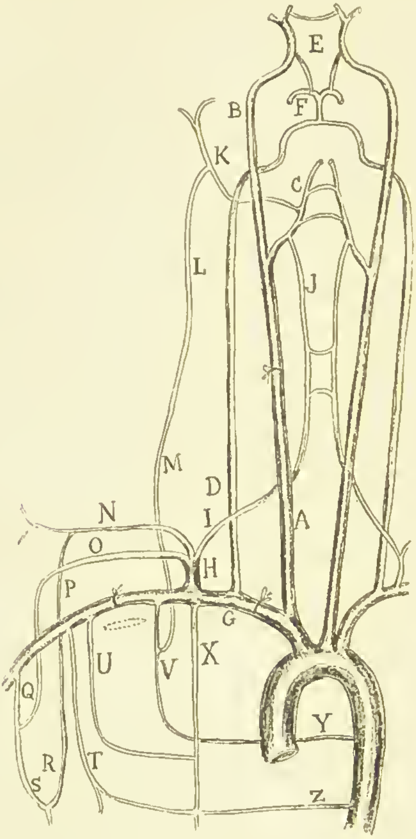


FIG. 79.—Diagram to show the collateral circulation after ligature of common carotid, subclavian and axillary arteries. A. Common carotid ; B. Internal carotid ; C. External carotid ; D. Vertebral ; E. Circle of Willis ; F. Basilar ; G. Subclavian ; H. Thyroid axis ; I. Inferior thyroid ; J. Superior thyroid ; K. Occipital ; L. Princeps cervicis; M. Deep cervical; N. Transversalis colli ; O. Suprascapular; P. Posterior scapular ; Q. Dorsalis scapulæ ; R. Infrascapular ; S. Subscapular ; T. Long thoracic ; U. Short thoracic ; V. Superior intercostal ; X. Internal mammary ; Y. and Z. Aortic intercostals.

1, injury of the external jugular vein or other veins, and profuse venous hæmorrhage; 2, wound of the sac of the aneurism; 3, puncture of the pleura; 4, inclusion of the lowest cord of the brachial plexus; 5, injury of the phrenic nerve. The *chief dangers after ligature* are pleurisy, suppuration of the sac, and secondary hæmorrhage. The *collateral circulation* (Fig. 79) after ligature of the third portion is carried on by—1, the supra scapular and posterior scapular arteries anastomosing with the infrascapular and subscapular and dorsalis scapulæ arteries; 2, the internal mammary, superior intercostal and aortic intercostal arteries anastomosing with the long and short thoracic arteries.

THE AXILLARY ARTERY can seldom require ligature except for wound or rupture (p. 187). In its continuity it may be tied in the first, second, and third part of its course. In *the third part* it can be readily secured by making an incision, with the arm raised, through the skin and fascia along the inner border of the coraco-brachialis and biceps. In *the first and second parts* of its course it lies below the pectoral muscles, and to expose it so deep a dissection is required, that ligature of the subclavian is preferable. *Collateral circulation*, see Figs. 79 and 80.

THE BRACHIAL ARTERY may require ligature for—1, wound of the artery; 2, aneurism at the bend of the elbow; 3, wound of the palmar arch. It may be tied

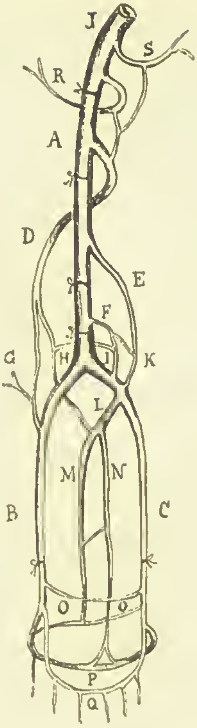


FIG. 80.—Diagram to show the collateral circulation after ligature of the axillary, brachial and radial and ulnar arteries. A. Brachial; B. Radial; C. Ulnar; D. Superior profunda; E. Inferior profunda; F. Anastomotica magna; G. Radial recurrent; H. Interosseous recurrent; I. Anterior and K. posterior ulnar recurrent; J. axillary; L. Common interosseous; M. posterior interosseous; N. Anterior interosseous; O. O. Anterior and posterior carpal; P. Deep palmar arch; Q. Superficial palmar arch; R. Posterior circumflex; S. Subscapular.

in any part of its course. Make an incision along the inner edge of the biceps in a line drawn from the anterior fold of the axilla to the middle of the bend of the elbow through the integuments and deep fascia, avoiding the basilic vein which lies over the course of the artery but superficial to the fascia. The median nerve crosses the artery along the middle of its course from without inwards. At the *bend of the elbow* make the incision obliquely from within outwards and divide the semilunar fascia of the biceps, and the artery will be found between the tendon of the biceps on the outer side and the median nerve on the inner side. The *collateral circulation* (Fig. 80) when the artery is tied below the inferior profunda is carried on by the anastomosis of the superior profunda with the radial and interosseous recurrent and anastomotica magna; and of the inferior profunda with the posterior ulnar recurrent.

THE RADIAL AND ULNAR ARTERIES may be tied for—1, aneurism of either vessel, or, 2, wound of the palmar arch; but it is a question whether ligature of the brachial is not preferable in the latter case as the anastomosis between the radial and ulnar and the carpal and interosseous arteries is so free (Fig. 80). Both arteries in the case of a wound of the palmar arch need to be tied. This is best done *at the wrist*, where they are superficial and can be felt pulsating. The radial lies between the supinator longus and the flexor carpi radialis; the ulnar between the innermost tendon of the flexor sublimis digitorum, and the flexor carpi ulnaris, by which it is slightly overlapped. An incision about an inch long through the integuments and deep fascia parallel to the course of either vessel, is all that is necessary to expose them. In the case of the ulnar, however, the flexor carpi ulnaris may have to be held aside. The aneurism needle should be passed from the ulnar to the radial side to avoid the nerve which lies to the ulnar side. In the case of the radial, the needle may be passed either way, as the radial nerve at the wrist is not in contact with the artery. No harm will ensue if the venæ comites are tied with their respective vessels. *The radial artery in the upper third* lies deeply between the supinator longus and pronator radii teres. Make an incision in a line drawn from the middle of the bend of the elbow to half an inch internal to the styloid process of the radius. Separate the muscles and the artery will be exposed. The radial nerve in this situation is some distance to the outer side of the artery. *Ligature of the ulnar in the upper third* is more difficult as it lies beneath the superficial flexor muscles. Make an incision four inches long in a line drawn from the front of the internal condyle to the radial side of the pisiform bone. Seek the interval between the flexor carpi ulnaris and the flexor sublimis digitorum. Separate these muscles and the ulnar nerve will be seen. Work superficial to the nerve and the artery will be found between the flexor sublimis and flexor profundus digitorum. For *Collateral circulation* see Fig. 80.

THE EXTERNAL ILIAC ARTERY may require ligature for:—1. Aneurism in the groin; 2, secondary hæmorrhage from the femoral; 3, a wound of the vessel itself. A line drawn from half an inch below and a little to the left of the umbilicus to the middle of Poupart's ligament indicates its course. Make a curved incision beginning a little external to the centre of Poupart's ligament upwards and outwards for about three inches towards the anterior superior spine of the ilium (Fig. 224, C.). Divide the skin, superficial and deep fascia, and the aponeurosis of the external oblique, cut more carefully through the internal oblique and transversalis muscles, and the fascia transversalis will be exposed. Divide this on a director, taking care not to injure the peritoneum. Separate the peritoneum gently from the psoas muscle, and let an assistant press it carefully upwards and inwards. The artery will now be felt beating at the inner part of the wound along the inner border of the psoas. Pass the aneurism needle from within outwards to avoid injuring the vein which lies to the inner side of the artery. The small crural branch of the genito-crural nerve lies on the artery, and the circumflex iliac vein and vas deferens cross it just before it passes under Poupart's ligament. The *chief accidents* that may occur during ligature are:—1. Injury of the peritoneum; 2, wound of the vein; 3, wound of the spermatic cord; 4, wound of the epigastric artery; and 5, puncture of the circumflex iliac vein. The *chief dangers* after ligature are:—1. Gangrene of the limb; 2, peritonitis; 3, secondary hæmorrhage. Should secondary hæmorrhage occur, carefully applied pressure must be tried. If this fails, nothing is left but the desperate expedient of cutting down on the bleeding vessel and trying to secure it. Davy's lever should be used to control the hæmorrhage during the operation. The peritoneum will be probably opened, and success can hardly be hoped for. The *collateral circulation* (Fig. 81) is carried on chiefly by the anastomosis between the internal mammary and deep epigastric; the ilio-lumbar and circumflex iliac; the gluteal and external circumflex; the obturator and internal circumflex; the sciatic and the superior perforating and internal circumflex.

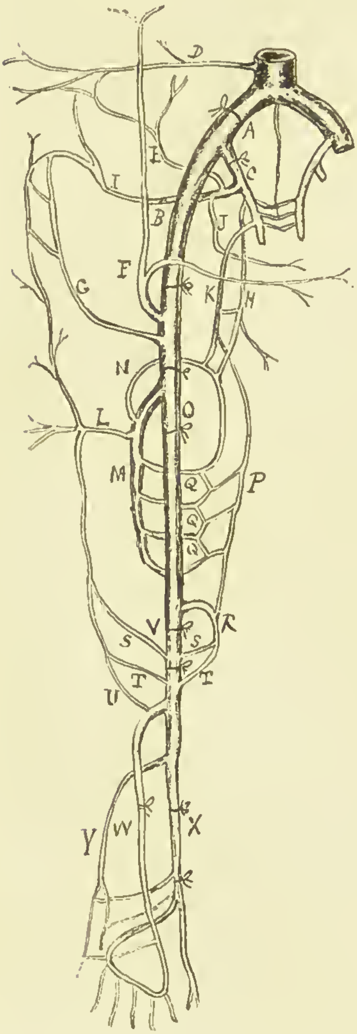


Fig. 81.—Diagram of the collateral circulation after ligature of the common iliac, external and internal iliac, femoral, and arteries of lower extremity. A. Common iliac; B. External iliac; C. Internal iliac; D. Last lumbar; E. Ilio-lumbar; F. Epigastric; G. Circumflex iliac; H. Obturator; I. Gluteal; J. Lateral sacral; K. Sciatic; L. External circumflex; M. Profunda; N. Internal circumflex; O. Femoral; P. Comes ischiatici; QQQ. Perforating; R. Anastomotica magna; SS. Superior articular; TT. Inferior articular; U. Tibial recurrent; V. Popliteal; W. Anterior tibial; X. Posterior tibial; Y. Peroneal.

THE COMMON ILIAC ARTERY has been ligatured for aneurism of the external iliac and for gluteal aneurism; THE INTERNAL ILIAC ARTERY, also for gluteal aneurism. Both may be reached by prolonging the incision for ligature of the external iliac, and both have recently been tied through the peritoneum. Both operations have been hitherto attended with the most unfavourable results. For *collateral circulation* see Fig. 81.

THE SUPERFICIAL FEMORAL ARTERY may be ligatured for:—1. Wound of the artery itself; 2, popliteal aneurism; 3, hæmorrhage from a wound of one of the tibials. The ligature may be applied either in Scarpa's triangle or in Hunter's canal. *In Scarpa's triangle* the artery is usually tied at the apex where the sartorius touches the adductor longus. If thought necessary, the line of the sartorius may be marked on the skin with lunar caustic by putting the muscle in action before the patient is anæsthetized. Slightly flex the leg, and place the thigh on its outer side in a position of slight abduction and flexion. A line drawn from a point midway between the symphysis pubis and the anterior superior iliac spine to the adductor tubercle in this position indicates the course of the artery. Make an incision about three inches long in this line, beginning about four inches below Poupart's ligament; cut through the skin and superficial fascia, and divide the deep fascia on a director. Draw the sartorius gently outwards and the sheath of the vessel will be exposed. Open this in the usual way, avoiding the small branch of the internal cutaneous nerve which crosses the artery at this spot. Pass the aneurism needle from within outwards to avoid injuring the vein which lies to the inner side of, and a little posterior to, the artery. *In Hunter's canal* the same line as the above indicates the course of the vessel. Place the limb as before, and make an incision three or four inches long in the line of the artery in the middle third of the thigh. Divide the superficial and deep fascia, and the sartorius will be exposed. It may be known by its fibres running downwards and inwards. Draw the muscle to the *inner* side, and the aponeurotic covering of Hunter's canal (known by its strong transverse fibres) will be seen. Divide it on a director, and the artery will be found lying between the vastus internus on the outer side and the adductor longus and magnus on the inner side. The vein is behind and a little external to the artery. The long saphenous nerve crosses the artery from the outer to the inner side. Pass the aneurism needle from without inwards, keeping the point well applied to the vessel, as the vein in this situation is usually very adherent to the artery. The *chief dangers* after ligature are:—1. Gangrene; 2, secondary hæmorrhage; 3, phlebitis and pyæmia from pricking the vein (see p. 284). The *collateral circulation* (Fig. 81) is carried on by the anastomosis between the perforating branches of the profunda and the articular branches of the popliteal; the descending branch of the external circumflex and external articular branches of the popliteal and tibial recurrent; and the artery of great sciatic nerve and internal articular branches of popliteal.

THE POSTERIOR TIBIAL ARTERY.—*In the upper third.* Place the limb on its outer side, and make an incision four inches long parallel, and half an inch posterior to the inner border of the tibia. Divide only the skin and superficial fascia in the first incision to avoid injuring the long saphenous vein. Then divide the deep fascia and draw the gastrocnemius, if seen, backwards; cut through the tibial origin of the soleus, and the inter-muscular fascia will be exposed. Divide this on a director, and the artery will be found lying on the tibialis posticus with the nerve to its outer side. *At the ankle.*—Make a curved incision over the artery a finger's breadth behind and below the internal malleolus. Divide the superficial and deep fascia and the internal annular ligament and the artery will be found between the tendons of the flexor longus digitorum and flexor longus pollicis with the nerve to its outer side. *Collateral circulation*, see Fig. 81.

THE ANTERIOR TIBIAL ARTERY.—A line drawn from the inner side of the head of the fibula to midway between the two malleoli indicates the course of the vessel. *In the upper third* make an incision about five inches long in the line of the artery through the skin and superficial fascia and look for the innermost white line, which indicates the cellular interval between the tibialis anticus and the extensor longus digitorum. Divide the deep fascia over this line on a director; hold the muscles apart by retractors, and the artery will be found on the interosseous membrane with the nerve to its outer side. *In the middle third* the artery lies between the tibialis anticus and extensor proprius pollicis, and the nerve lies on the artery. *In the lower third* the artery lies between the extensor proprius pollicis and the extensor longus digitorum with the nerve on its outer side. An incision in the line of the artery and the separation of the muscles is all that is necessary to expose the vessel in either of these situations. *Collateral circulation*, see Fig. 81.

THE DORSALIS PEDIS ARTERY may require ligature for a wound on the dorsum of the foot. I have twice seen it tied for aneurism of the vessel itself. Make an incision in a line drawn from midway between the two malleoli to the interval between the great and second toes; divide the skin and the superficial and deep fascia, the artery will be found between the extensor proprius pollicis and the innermost tendon of the extensor longus digitorum. As the artery sinks into the sole it is crossed by the innermost tendon of the extensor brevis digitorum. The anterior tibial nerve is on the outer side.

DISEASES OF THE VEINS.

THROMBOSIS, or clotting of the blood in a vein, is very common, and was formerly thought to be always the result of inflammation of the vein-wall. Hence, whenever a vein became thrombosed, the condition was spoken of as phlebitis. It is now known, however, that a thrombus may form in a vein without any inflammation of its walls, and that the presence of a thrombus is in some cases the cause and not the result of the inflammation. *The causes* of thrombosis may be considered under the following heads. 1. *Changes in the vein-wall*, such as may result from injury, inflammation, and degenerative proccsses. 2. *Changes in the blood*, such as occur in septicæmia and pyæmia and other affections in which there is a destruction of the white corpuscles, and the consequent setting free of the fibrin ferment contained in them. The exact nature of the changes in the blood inducing thrombosis is, however, not known, and the above explanation is at the best a mere theory. 3. *The presence of micro-organisms.* 4. *The retardation or arrest of the blood-stream*, as (*a*) when a ligature is applied to a vein; (*b*) when a vein is compressed by a tight bandage, tumour, or contraction of a cicatrix; (*c*) when the blood flows feebly through a vein owing to weak action of the heart induced by age, fevers, loss of blood, &c. 5. *The presence of a foreign body not covered by endothelium*, as a piece of ligature, an embolus, an already formed thrombus, or the protrusion of a new growth into the lumen of a vein.

Method of extension of the thrombus.—When once formed the thrombus may extend either with or against the blood-stream. As a rule, however, it takes the former direction, extending from the smaller to the larger veins, and in this way it may at times reach the heart.

Appearances of a recent thrombus.—When the blood is at rest at the time of coagulation, as when a vein is ligatured, the thrombus will be red throughout, as both the coloured and colourless corpuscles equally become entangled in the fibrin. It will fill the whole lumen of the vein, and at first will be soft and gelatinous, and but loosely attached to the vein-wall. When, on the other hand, the clot is formed gradually whilst the blood is in motion, as when the clot is deposited on an unhealthy vein-wall, the clot is laminated, and firmly adherent to the wall, and will be either white or tinged with red, according to the rate at which it is formed. A *post-mortem* clot may be distinguished from the above in that it does not adhere to the wall of the vessel, nor as a rule entirely fill its lumen. It is never laminated, although it may consist of two layers, one white and one red.

Changes in the thrombus.—1. The clot may become converted, together with that portion of the vein in which it is contained, into a fibrous cord. Thus it first loses its red colour from the disappearance of the red corpuscles, then becomes firmer, more adherent to the wall of the vein, and finally indistinguishable from it. The minute changes which occur in this process are similar to those already described in the healing of an artery after injury (page 116). 2. The clot may undergo calcification and become converted into a so-called vein-stone or phlebolith, which may either be found free, or attached to the walls by a pedicle. 3. The clot may soften and disintegrate, forming a pultaceous reddish material or a yellowish-red puriform fluid, the latter change being probably due to the action of septic micro-organisms. 4. The clot may shrink to one side of the vein, or become tunnelled by the blood, or it may be slowly carried away by the circulation without causing any mischief. The tunnelling of the clot is brought about by the gradual enlargement of the small vessels which normally permeate the clot during its conversion into a fibrous cord.

The effects of thrombosis are, 1. *Swelling and œdema* of the parts from which the affected vein returned the venous blood. This may completely or partially disappear, or it may remain permanent constituting the condition known as *solid œdema*, according to whether the lumen of the vein is or is not restored, or the collateral channels are sufficient for the requirements of the circulation. A good example of œdema from thrombosis is furnished by the so-called white leg, or *phlegmasia alba dolens*, so common after parturition as the result of the extension of the clot from the uterine veins through the iliacs to the femoral. 2. *Gangrene* occasionally occurs after the plugging of a large vein where the collateral circulation is insufficient to relieve the engorgement of the part, and is necessarily of the moist variety. 3. *Phlebitis*, or inflammation of the vein-walls, may ensue, and will take a simple or a spreading and suppurative form, according as the thrombus is of a simple or of a septic or infective nature. 4. *Embolism*, owing to a portion of a thrombus being swept away by the blood-stream and becoming lodged in a distant vessel. The way in which this detachment may take place is shown in Fig. 35, p. 148. If the thrombus is of a simple character, no harm may ensue: but if septic or infective, the embolus will also be septic or infective, and set up a like inflammation in the part where it becomes arrested. (See *Pyœmia*, p. 145.)

Signs.—When the deep veins are plugged, the only evidence of the thrombosis will be signs of obstruction to the circulation in the veins below, such as œdema or dilatation of the superficial veins. When, however, a superficial vein, as one of the saphenas, is affected, there will be a hard cord-like swelling in the situation of the vein, and some tenderness on pressure and feeling of stiffness on movement. Should inflammation of the vein follow from the presence of the thrombus, there will be in addition some heat and redness of the skin. (See *Phlebitis.*)

Treatment.—Absolute rest in the recumbent position is essential, lest a portion of the clot should become detached and lodged in an important organ, as the brain, or plug the pulmonary artery, and sudden death ensue. Where there is much œdema, the part should at first be elevated, and subsequently evenly and firmly bandaged.

PHLEBITIS, or inflammation of veins, may be divided into the simple, and the septic or spreading.

Simple phlebitis, formerly known as *adhesive phlebitis*, is a simple local inflammation of the vein-wall, and may terminate in resolution, obliteration of the vein, or more rarely in the formation of a localized abscess. *Causes.*—1. Injury of the vein-walls. 2. Simple inflammation of the surrounding tissues. 3. The formation of a non-infective thrombus in a vein. 4. Gout or the gouty diathesis. 5. Certain conditions of the system the exact nature of which is not known, the phlebitis being then spoken of as idiopathic.

Pathology.—The walls of the vein become infiltrated with leucocytes and swollen, whilst a thrombus, should not such already be present as the cause of the inflammation, will form in the interior of the vein. Changes similar to those already described under thrombosis may then occur in the clot. Thus the vein may become obliterated, or the thrombus variously disposed of and the calibre of the vein restored. Or suppuration may take place, which however does not spread unless septic processes are set up on the evacuation of the pus.

Symptoms.—There is the same cord-like swelling in the affected part of the vein as in simple thrombosis, but the skin, at least when a superficial vein is involved, is dusky-red and œdematous, and pain is more severe on pressure and on movement. When a vein of large size is affected, there will be in addition signs of obstruction to the venous circulation. The gouty form is either associated with ordinary gouty inflammation in the foot or joints, or occurs with little or no evident provocation in persons of marked gouty constitution, or with a gouty inheritance. It is more especially characterized by its symmetry, apparent metastasis, and frequent recurrences.

The treatment is similar to that of thrombosis. Where there is much pain, an ointment of glycerine and belladonna may be smeared over the vein, or lead and opium lotion, or hot linseed-meal poultices may be applied. Should an abscess form, it must be opened with antiseptic precautions, care being taken not to disturb the clots. Saline purgatives should be given, with potash and colchicum in the gouty, and the patient placed on low diet.

SUPPURATIVE PHLEBITIS is a spreading, septic inflammation of the vein-walls and tissues around. *Causes.*—It is due to septic or infective inflammation spreading to the vein-walls or to a thrombus filling the vein. Thus, it is frequently met with in connection with compound fractures, ill-conditioned stumps, acute necrosis, osteomyelitis, diffuse cellulitis, malignant pustule, facial carbuncle, &c. It may also follow the opening of an abscess, the result of simple phlebitis, if septic or infective processes are allowed to take place in the wound. *Pathology.*—The coats of the inflamed vein become red, swollen, and in places soft and diffluent, and the thrombus softened into a purulent fluid, whilst micro-organisms are found both in it and in the vein-walls. These changes gradually extend up the vein, and should portions of the septic thrombus be carried away by the blood-stream, metastatic abscesses in distant parts and general blood-poisoning will result (*septicæmia* or *pyœmia.*) *Symptoms.*—When a superficial vein is affected there is at first a cord-like swelling as in simple phlebitis, but redness and œdema of the skin soon supervene, followed by fluctuation in one or more situations in the course of the vein, and frequently by general blood-poisoning. When the deep veins are involved, the disease may not be suspected until signs of septicæmia or pyæmia set in, and the condition of the veins can then only with certainty be ascertained on a *post-mortem* examination being made. The *treatment* resolves itself into controlling or arresting, if possible, the septic or infective inflammation in the part from which the suppurative phlebitis starts. Beyond this, little can be done, although, could the condition of the veins be diagnosed with certainty, amputation above the inflamed part might, before general blood-poisoning had supervened, save the patient's life. When the vein is superficial, cutting out a piece above the disease has been suggested; but cases to which such treatment would be applicable must be very rare, as the inflammation is seldom limited to a superficial vein.

VARICOSE VEINS.—A vein is said to be varicose when it is permanently and unequally dilated, and its coats have undergone certain degenerative changes. A varicose condition is most common in the veins of the lower extremities, and in the veins of the rectum and testicle (see *Piles and Varicocele*).

The *causes* may be considered under the heads of increased intra-venous pressure, and changes in the vein-walls. A. *Increased intra-venous pressure* may be due to 1. Organic affections of the heart whereby the return of venous blood is impeded. 2. Obstruction to the circulation in the portal system, a cause chiefly affecting the hæmorrhoidal veins (see *Piles*). 3. Pressure upon the veins, such as may be exerted (*a*) by the gravid uterus or a tumour of the uterus or of the ovaries on the iliac veins; (*b*) by an aneurism of the abdominal aorta on the inferior vena cava; (*c*) by fæcal accumulation on the hæmorrhoidal veins; (*d*) by a tumour in the groin on the femoral vein; (*e*) by an ill-fitting truss on the spermatic veins (see *Varicocele*); or (*f*) by a tight garter on the saphenous veins. 4. Long-standing, which has a tendency to cause the accumulation of blood in the veins of the lower extremity. 5. Severe muscular exertion, whereby an increased amount of blood is driven from the deep veins by the contraction of the muscles into the superficial. Some authors consider this the chief, if not the only cause of varicose veins of the lower extremities. They maintain that the pressure of the blood first produces a dilatation of the superficial veins where the intermuscular veins empty into them; that this dilatation being frequently repeated becomes permanent; that the valves in consequence are unable to close and protect the veins, and being thrown out of use gradually undergo atrophy, whilst the weight of the column of blood, from the inefficiency of the valves, becomes further increased, and the veins still further dilated. B. *Changes in the vein-walls.*—These consist principally in an hereditary weakness, want of muscular tone, and inflammatory softening of the walls. Varicose veins are more common in men than in women, owing to their more frequent exposure to the exciting causes; women, however, are peculiarly liable to them during pregnancy.

Pathology.—A varicose vein is lengthened, dilated, and frequently tortuous (Fig. 82), the dilatation being especially marked where the intermuscular veins open into the superficial, and at the situation of the valves. The middle, and to a less extent the outer coat, are often greatly thickened by the formation of fibrous tissue, but the inner coat shows little change. In the dilated portions immediately above the valves the coats, on the other hand, may be found greatly thinned, so that the vein may give way at these situations. The valves themselves, from the dilatation of the veins, cease to be of service, and become atrophied and frequently reduced to mere ridges or fibrous cords. Thus the intravenous pressure in the segment below is increased as the column of blood in the upper part of the vein is no longer supported by the valves. The deep veins are generally involved in the varicose condition, and the smaller radicals returning the blood to the varicose vein from the skin often share in the dilatation. The skin, in consequence of the obstruction to the venous return, becomes congested and chronically inflamed (*varicose eczema*), and frequently gives way, producing an ulcer (*varicose ulcer*); whilst at times the pressure of the vein causes thinning of the skin, and this, with the wall of the vein, may give way, and hæmorrhage result. When the valves have been destroyed, the hæmorrhage may be very severe, and even terminate in death, as the blood sometimes flows backwards from the heart through the proximal end, as well as through the distal end of the vein.

The *symptoms* usually complained of are fatigue and a sense of fulness of the limb after exercise or long standing, and perhaps cramp, coldness of the feet, swelling and œdema of the ankle, and numbness of the leg. Sometimes there is deep-seated pain. The tortuous vein or veins meandering up the leg is a characteristic sign which cannot be mistaken. When the smaller radicals are affected bluish clusters of minute veins are visible here and there, especially about the ankle and knee.

The *treatment* may be palliative or radical. *Palliative treatment* consists locally in supporting the dilated vein by an elastic stocking or by a Martin's or an ordinary bandage, and reducing the hours of standing where possible. The bowels at the same time should be regulated, and the general health improved by tonics, iron, &c. *Radical treatment* should only be undertaken under exceptional circumstances, as 1, when a vein appears likely to burst; 2, when there is a knotted mass of large veins in one or more situations, giving rise to much pain and inconvenience; 3, when an intractable ulcer is present; and 4, when the varicosity is chiefly confined to a single vein.

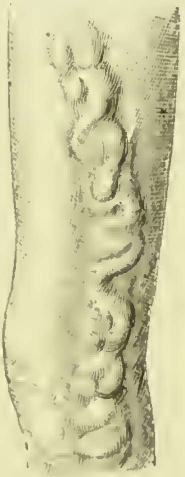


FIG. 82. — Varicose veins. (From Bryant's Surgery.)

Many methods of operating have been proposed. The object aimed at in all is to obliterate the vein, either, 1, by exciting adhesive inflammation as by acupressure, coagulating injections, ligature, or caustics: or 2, by excising a portion of the vein itself. *Acupressure* consists in passing a needle beneath the vein in several situations, and compressing the vein between the needle and a piece of bougie placed over the vein by means of a figure-of-8 suture. The *injections* chiefly employed are perchloride of iron and carbolic acid. If they are used, the vein should be compressed above till the blood at the spot of injection has had time to coagulate. If a *subcutaneous ligature* is employed, it should consist of carbolized silk or some other antiseptic material. The *caustic* method consists in placing Vienna paste in various situations over the vein; it sets up inflammation and ulceration of the skin, which spreads to the vein and causes its obliteration. *Excision* of a portion of the vein after a ligature has been applied above and below is a method commonly employed at St. Bartholomew's Hospital, and appears on the whole to be the best and most certain method of radical cure. Whatever operation is undertaken, however, the patient should be kept at rest in the recumbent position to prevent a portion of the thrombus becoming detached and the consequent danger of embolism in vital organs; whilst the strictest precautions should be taken to keep the wound aseptic, lest suppurative phlebitis and its consequences (*sapræmia*, *septicæmia*, *pyæmia*) ensue.

NÆVUS.

There are two chief varieties of nævus, the capillary and the venous, but both forms may be combined.

THE CAPILLARY NÆVUS or *plexiform angioma* consists of a mass of dilated and tortuous capillaries bound together by a scanty amount of connective tissue. These nævi are most common on the head, neck, face and chest; and occur as small, flat, or slightly-elevated, red or purplish-red patches on the skin or mucous membrane. Sometimes they are spread out as a thin layer covering perhaps the greater part of one side of the face, and are then known as *port-wine marks*. The blood can be pressed out momentarily, but returns when pressure is removed. Their rate of growth varies; sometimes it is quick, at other times it is slow; or they may remain stationary, or disappear spontaneously. *Treatment.*—The smaller nævi may readily be destroyed by nitric acid or ethylate of sodium. Those known as "port-wine marks" should be left alone.

THE VENOUS NÆVUS or *cavernous angioma* consists of a number of cavernous spaces lined with endothelium and communicating with each other, and with the arteries on the one hand and the veins on the other. They form distinct tumours bound together by delicate connective tissue sometimes containing fat. The blood in them is of a dark venous colour. They are generally subcutaneous, but may likewise occur beneath a mucous membrane. They are always congenital. They appear as irregular, nodular, soft, compressible tumours, easily emptied by pressure, but quickly refilling, and swelling up on coughing or crying. When under a mucous membrane they are of a bluish-purple colour. The skin or mucous membrane covering them may be natural, or it may be affected with the capillary variety of nævus. Their favourite seats are the lips, cheeks, scalp, organs of generation, back, and nates. They may gradually increase in size, remain stationary, or undergo a spontaneous cure.

Treatment.—The indications are to remove or to destroy the nævus with as little scarring as possible. This may be done by, 1, excision with the knife; 2, ligature; 3, coagulating injections; 4, setons; 5, electrolysis.

1. *Excision with the knife* is a rapid, painless, and effective method, and where, as in the lip, by removing a V-shaped piece a mere linear scar is left, is, perhaps, the best. To avoid hæmorrhage, however, the incision should be made wide of the growth.

2. *Ligature* is a sure, simple, and safe method, but is painful, slow, and leaves a scar. The ligature may be applied in several ways. All that can here be said is that the ligature should consist of whip-cord or China silk; that it should be applied by a nævus needle, either subcutaneously, or, if this is impracticable, through an incision made in the skin round the nævus; and that it should be tied tightly in a reef knot to ensure complete strangulation.

3. *Coagulating injections.*—The materials most often used are perchloride of iron, carbolic acid, and chloride of zinc. Only a drop or two should be injected, as otherwise sloughing may occur, or the coagulation may spread to the blood in the veins, and embolism, resulting perhaps in sudden death, may ensue. To avoid this accident the base of the nævus must be compressed by a clamp or a ligature during and for a short time after the operation.

4. *Setons.*—A simple thread, or one soaked in perchloride of iron, passed through the nævus and left in for a week, may effect a cure by causing adhesive inflammation. This method is sometimes useful where others are inapplicable.

5. *Electrolysis* is indicated when it is important to save the skin and reduce the scar to a minimum, as in venous nævi about the face. It consists in passing two or more needles into the nævus in different situations, and sending a weak constant current through them; or better, passing needles connected only with the positive pole of the battery into the nævus, and rubbing a rheophore connected with the negative pole over the skin of some other part of the body. Should bubbles of gas escape the current must be reduced in strength. Before removing the needles from the nævus the current should be reversed for a few seconds in order that the salts of iron may be formed around the needles, and so prevent bleeding from the punctures. The operation must be repeated many times, as if too strong a current is used sloughing will take place.

ARTERIAL VARIX, or a dilated, tortuous and irregularly pouched condition of an artery similar to that of a vein in varix, CIRSOID ANEURISM, or a pulsating tumour composed of several lengthened, dilated and pouched arteries, and ANEURISM BY ANASTOMOSIS, or a localised dilatation of arteries, veins, and capillaries, are too rare to require description here.

DISEASES OF THE LYMPHATICS.

LYMPHANGITIS or inflammation of the lymphatic vessels is generally associated with more or less inflammation of the lymphatic glands. *Causes.*—The most common cause is the absorption of septic or of infective products from a wound, which, however, is often very trivial, such as a simple scratch, abrasion, sting, or puncture; more rarely, the inflammation may follow upon mere irritation of the skin, as a chafe of the heel, excessive friction, or sun-burn. *Pathology.*—The walls of the lymphatics become infiltrated with cells, swollen, and softened, whilst the endothelium is shed, and the lymph contained in the vessels often undergoes coagulation. The inflammation spreads to the surrounding tissue, but seldom higher in the course of the lymphatics than the first set of glands, which also become swollen and infiltrated and arrest the further absorption of the septic products. It may *terminate* in resolution, or in suppuration in and around the glands, or more rarely around the lymphatics themselves. Sometimes the septic products appear to escape the glands, and general blood-poisoning ensues. *Symptoms.*—In severe cases, lymphangitis generally begins with a chill or rigor, followed by high temperature and fever, and perhaps vomiting and diarrhœa. Red lines, when the superficial lymphatics are affected, are seen running from the wound to the nearest lymphatic glands, with here and there erysipelatous-like patches of redness. There is generally pain and tenderness, especially in the region of the swollen glands, and swelling and œdema, sometimes of the whole limb. It may be diagnosed from phlebitis by the redness being superficial and in the course of the lymphatics, not in the course of the veins; by the absence of the cord-like and knotty feel of plugged veins, and by the presence of glandular enlargement; from erysipelas by the redness having no defined margin, and generally running in lines. The *treatment* consists in attending to any wound or abrasion, allaying other sources of irritation that may be present, and placing the inflamed part at rest in an elevated position. Hot fomentations or poultices, or glycerine and belladonna may be applied, and abscesses should be opened as soon as they form. If any swelling is left, pressure in the form of Scott's dressing or ammoniacum and mercury plaster may be used to disperse it.

LYMPHATIC VARIX or LYMPHANGIECTASIS is very rare. When the superficial vessels are affected, "the varix first appears in the form of small elevations, giving the skin an appearance which has been compared to the rind of an orange. It subsequently takes the form of little vesicles, covered with a thin layer of dermis." (Erichsen.) At times the dilated lymphatics form distinct tumours (*Lymphangiomata*). *Treatment.*—Slight elastic pressure, and protection from injury or irritation.

LYMPHATIC FISTULA or LYMPHORRHŒA, though exceedingly rare, is a condition sometimes met with, and more especially in the groin, scrotum, or labium. It is said to be due to a wound of a lymphatic, or to the giving way of a varicose lymphatic, but the cause is not clearly understood.

LYMPHADENITIS, or inflammation of the lymphatic glands, may be acute, subacute, or chronic.

Acute and subacute inflammation is nearly always secondary to inflammation of the parts from which the afferent lymphatics proceed. Indeed, in most inflammations, there is some tenderness of the neighbouring glands.

The lymphatic vessels themselves, although the glands may become extensively involved, and even suppurate, often escape. The inflammation, however, rarely proceeds further in the course of the lymphatics than the first series of lymphatic glands, although it often spreads to the surrounding tissues (*peri-lymphadenitis*). The changes in the inflamed gland are like those of other inflammations. The whole gland is enlarged, the vessels dilated, and the lymph-sinuses crowded with cells. Micro-organisms, similar to those found in the inflammatory lesion giving rise to the lymphadenitis, have been discovered in the glands. The *signs* are tenderness, heat, pain and swelling, followed by redness of the skin and œdema. The gland, at first moveable, becomes fixed, and if the process runs on into suppuration, the usual signs of an abscess ensue. Familiar examples of lymphadenitis are seen in the bubo of gonorrhœa, in the tender glands of erysipelas, and in the suppurating bubo of soft chancre. The *treatment* consists in subduing the inflammation of the part from which the lymphatics proceed. painting the glands with glycerine and belladonna, applying a hot poultice, and, if suppuration occurs, in making a free incision.

Chronic lymphadenitis is very common in strumous children, especially in the neck. The affection of the glands can frequently be traced to some exciting cause, as the irritation of pediculi on the head, eczematous affections about the mouth, enlarged tonsils, or carious teeth. In other cases, it appears to depend upon the presence of the tubercle bacillus. See *Struma* and *Tubercle*, pp. 42 and 45. The glands slowly enlarge, and become infiltrated with small round cells; whilst in the tubercular cases, non-vascular areas containing giant-cells, lymphoid corpuscles, and the tubercle bacillus are found. The enlargement may subside, or the inflammatory products may caseate, and suppuration occur in, or in and around the gland; at times, the caseous mass may dry up and become cretaceous, or atrophy or fibroid thickening may ensue. In rare instances the tubercle may become disseminated, leading to general tuberculosis. *Signs.*—The glands, when those of the neck (the most common situation) are affected, become enlarged on one or both sides of the neck, without pain. They are at first distinct and moveable, but later often coalesce and become adherent to the surrounding parts. After a time, they may soften and break down; the skin then becomes adherent and red, gives way, and a curdy pus is exuded. After the abscess has thus opened, a portion of the broken-down gland may be seen in the floor of the ulcer, the edges of which are bluish-pink, and undermined. See *Strumous Ulcers.* The ulcers are very indolent, and when finally healed, leave characteristic raised, puckered, pinkish-white scars. Concomitant signs of struma are frequently present. *Treatment.*—Any source of irritation, such as pediculi, carious teeth, &c., should be sought and removed, and the patient, if strumous, treated as indicated at p. 45. The glands had better be left alone, unless suppuration threatens, when they should be removed. If an abscess has already formed it should be opened early to prevent scarring. This may be done by a small incision, after which the capsule of the gland may be cleared out by a Volkmann's spoon. Should an indolent ulcer or sinus remain, as often happens if the abscess is allowed to burst spontaneously, it should also be scraped with a Volkmann's spoon, and its edges destroyed by nitrate of silver or potassa fusa, or better, cut away.

LYMPHADENOMA, or non-inflammatory enlargement of the lymphatic glands, consists of a simple hypertrophy of the gland tissue, and is often associated with *leukæmia*, or an increase of the white corpuscles of the blood, and with a general hypertrophy of the adenoid tissue of the body, especially of the spleen. The *cause* is unknown. One or two glands only may be affected (*simple lymphadenoma* or *lymphoma*), or many of the glands, especially those in the neck, axilla, and groin, or, indeed, all the glands of the body, together with the adenoid tissue in other organs (*Hodgkin's disease*). The enlargement differs from that of the inflammatory affections, in that the glands remain free and distinct, and form smooth, rounded or egg-shaped, firm, elastic, and generally painless swellings, which, as a rule, do not suppurate. When one or two glands only are enlarged, the general health is not affected; but when many are involved, and especially when associated with a leukæmic condition, the patient rapidly emaciates, becomes anæmic, the spleen enlarges, diarrhœa or dropsy may set in, and death usually results from exhaustion, or, it may be, from the pressure of the enlarged glands upon the trachea, bronchi, or some vital organ. *Treatment.*—Where one or two glands alone are enlarged they may be removed; but where large numbers are affected, no surgical treatment is of any avail, although if a gland is pressing upon the trachea, &c., it may be removed, or tracheotomy performed. In the non-leukæmic forms, arsenic, in increasing doses, may be given internally, with iron and cod-liver oil. For the treatment of the disease when associated with leukæmia, see a work on Medicine.

LYMPHO-SARCOMA is the term sometimes applied to primary sarcoma occurring in a lymphatic gland. (See *Sarcoma*, p. 74.)

DISEASES OF NERVES.

NEURITIS, or inflammation of nerves, occurs in the sheath or connective tissue binding the nerve-fibres together, and is therefore a perineuritis, or interstitial neuritis, and not an inflammation of the nerve-substance. *Causes.*—Injury, cold, rheumatism, syphilis, tubercle, lead-poisoning, gout, diphtheria, alcoholism, and fevers. *Pathology.*—In the acuter forms, the nerve appears slightly red and swollen, and later infiltrated with inflammatory exudation. In the more chronic cases the sheath and interstitial connective tissue appear thickened, whilst the nerve fibres are more or less atrophied. When following an amputation, partial division with laceration, or gunshot injury, the inflammation generally spreads up the nerve from the seat of injury (*ascending neuritis*). *Symptoms.*—There may be tenderness on pressure, or continuous pain with exacerbations in the course of a nerve and its peripheral branches, tingling and numbness in the part supplied by it, and occasionally spasm of the muscles. The pain is generally worse at night, and increased on movement. At times the nerve may be felt to be swollen, and there may be loss of sensation or muscular paralysis in the part it supplies. The acute cases are attended with slight fever. In the traumatic form, pressure at the seat of injury, or over the bulbous end, may cause great pain and muscular spasm. *Treatment.*—The cause, if possible, should be removed, alcohol forbidden, and appropriate remedies given if there be gout, syphilis, or signs of lead-poisoning, &c. Locally, hot fomentations or leeches, or belladonna and glycerine may be applied, and later, blistering fluid along the course of the nerve. Absolute rest of the part supplied by the nerve is imperative. In the traumatic form following amputation, stretching the nerve relieves for a time; but cutting out the bulbous end, division of the nerve, or resection of a portion, though said to do good, have, in my experience, failed to do so. Percussion of the nerve is well spoken of.

NEURALGIA is the term applied to pain, generally of a paroxysmal and violent character, in the course or distribution of a sensory or mixed nerve. The *causes* of neuralgia are very various. Thus, it may be due to—1, pressure on a nerve by a tumour or aneurism, or involvement of its end in a scar; 2, the presence of a foreign body in a nerve; 3, inflammation of a nerve from injury, exposure to cold, &c.; 4, irritation or injury of another nerve or its endings transferred or reflected—*e.g.*, supra-orbital neuralgia due to carious teeth, pain in the back consequent on uterine disease; 5, some constitutional condition, as debility induced by excessive child-bearing, mental depression, hysteria, exposure to malaria, &c.; 6, disease of the central nervous system; 7, unknown causes. *Symptoms.*—The usual sign is pain in the distribution or course of a nerve or of several nerves, generally violent, shooting, paroxysmal, and tingling. At times it may be attended with spasm of the muscles, hypersecretion of the glands and derangements of pigmentation of the hair and skin. The pain, except when it depends upon neuritis, may often be relieved by pressure. It is most common in the fifth nerve, *tic douloureux*, the sciatic nerve, *sciatica*, and intercostal nerves, *pleurodynia*. At other times it is localized to one organ, as the testis or breast, or to a joint. A special form known as *epileptiform neuralgia*, or *incurable tic*, sometimes affects the fifth nerve. The paroxysms are of short duration, but of a most excruciating character; they recur at varying intervals, and are brought on by the slightest cause, as pressure over the bony canal through which the nerve emerges on the face, a draught of cold air, taking food, &c. The pathology of it is quite unknown. *Simple neuralgia*, *i.e.*, pain the cause of which is not apparent, often simulates organic disease. Thus, pain in the course of an intercostal nerve may simulate pleurisy; neuralgia in a joint, joint-disease. It may be distinguished from such by the absence of signs of inflammation, of deep-seated pain, and of swelling and deformity; by the presence of increased cutaneous sensibility; and often by the fact that firm pressure relieves it.

Treatment.—The first indication is to remove the cause, for which a careful search should be made. Thus, carious teeth should be extracted, foreign bodies removed, &c.; the general health improved by tonics, iron, quinine, fresh air, &c.; and gouty, rheumatic, or other constitutional diatheses combated by appropriate means. When no cause can be discovered, the treatment must necessarily be empirical; and when one remedy fails, another must be tried. Thus, internally, quinine in large doses, arsenic, aconitine beginning with $\frac{1}{200}$ of a grain, nitroglycerine in one minim doses of a one per cent. solution, croton-chloral, gelsemium, tonga, antipyrin and phosphorus, may successively be given. Locally, the part may be painted with liniment of aconite or rubbed with ointment of aconitine; or the continuous current, the actual cautery, or small blisters applied; or morphia or osmic acid injected subcutaneously. Neurotomy, or dividing the nerve, and neurectomy, or cutting a piece out of the nerve, have long been practised, but are attended with but very temporary benefit. Nerve-stretching holds out better prospects of success. It consists in cutting down upon the nerve, catching it up with a blunt hook or aneurism needle passed beneath it, and forcibly stretching both the proximal and distal ends. The strain that a nerve will bear without breaking of course varies with its size, but it is very considerable. The sciatic nerve, which is sometimes stretched for sciatica, is so strong that the patient can be lifted up from the table by it without its giving way. This nerve, however, may be stretched by what is called the bloodless method—*i.e.*, by extending the leg on the thigh, and forcibly flexing the thigh on the body. The effect upon the pain produced by nerve-stretching is variously supposed to depend upon—1, some alteration of the molecular elements of the nerve which may be transmitted to the nerve-centres; 2, some alteration in its vascular or nervous supply; 3, the breaking down of adhesions which may have formed around it. This operation is not infrequently practised for obstinate epileptiform neuralgia. The relief it gives is unfortunately not always permanent, though considerable periods of immunity have been gained, and after the return of the pain the operation may be repeated. At any rate it appears to give more lasting relief than either neurotomy or neurectomy. Cases of epileptiform neuralgia that have resisted all other treatment, have, in several instances, been greatly benefited, if not cured, by the excision of Meckel's ganglion.

TUMOURS OF NERVES, whatever their structure, were formerly called neuromata. This term, however, should be restricted to that rare form of tumour composed of nerve elements; whilst other tumours of nerves should be called fibromata, sarcomata, &c., as in other situations, according as they consist of fibrous tissue, sarcoma elements, &c.

The true neuromata are exceedingly rare, and call for no further mention.

The fibromata, though, like other tumours of nerves, far from common, are the variety most frequently met with. They grow from the connective tissue either of the sheath, or its prolongations within the nerve; in the latter case the nerve-fibres will be spread out over them (Fig. 83). They are generally single, or there may be several on the same or on different nerves. *Signs.* They occur as painful, more or less globular tumours in the course of a nerve, and are often accompanied by numbness, tingling, and perhaps muscular spasm in the part it supplies. They can be swayed from side to side, but cannot be moved up and down in the long axis of the nerve. Another form of fibrous tumour connected with nerves is the so-called painful subcutaneous tumour of Paget, which occurs as a small nodule beneath the skin, and causes the most exquisite pain when handled. The *treatment* consists in dissecting the tumour out, or if this is impracticable, removing it along with the affected portion of the nerve, and then suturing the divided nerve-ends. If the divided ends cannot be brought into contact an attempt may be made to graft a piece of nerve between them. The painful subcutaneous tubercle is readily removed by dissection.

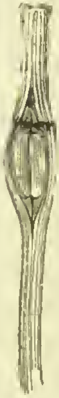


FIG. 83. — A median nerve, with a tumour over which the filaments are spread out. (St. Bartholomew's Hospital Museum.)

The myxomata are the next most common tumours of nerves, and give rise to similar symptoms.

The sarcomata, though more rare, may also be met with in nerves, and are sometimes multiple.

CONVULSIVE OR MUSCULAR TIC, or histrionic spasm as it is sometimes called, is a convulsive twitching of the muscles of the face, due to some form of irritation of the facial nerve the nature of which is not known. It is at times associated with neuralgia of the fifth nerve. Stretching the facial nerve just after it emerges from the stylo-mastoid foramen may be undertaken in severe cases. as, for instance, where the spasm interferes with sleep, &c., and with a fair prospect of success.

PERFORATING ULCER OF THE FOOT.—Though the pressure of a corn can generally be traced as the exciting cause of the ulcer, it would appear in many cases to depend upon changes in the peripheral nerves, leading to trophic changes in the part and a consequent less resisting power of the tissues to injury or pressure. It is sometimes associated with locomotor ataxia, at times with diabetes, and more rarely with spina bifida. The usual situation of the ulcer is the ball of the great or little toe. It is attended with but slight inflammation, and probing causes hardly any pain. It may lead to destruction of the metatarso-phalangeal joint, necrosis of the bones, and perhaps complete perforation of the foot; it is sometimes the starting-point of gangrene. There is usually local sweating, lowering of temperature, and impairment of sensation of the foot and lower third of the leg. The patella-reflex is often lost. *Treatment.*—Though the ulcer will sometimes yield to prolonged rest, the removal of dead bone, scraping, and other local treatment, amputation is often called for. Nerve-stretching has also been recommended.

SURGICAL DISEASES OF THE SKIN.

VERRUCÆ, OR WARTS, are small excrescences on the skin formed by the hypertrophy of the papillæ and epidermis. The following varieties are described. 1. *Verrucæ vulgares*, or common warts, so frequent on the hands of children and young adults. 2. *Verrucæ seniles*, which occur as brownish elevations generally about the back. neck, and arms of old people. 3. *Verrucæ necrogenicæ*. common on the hands of dissecting-room porters and morbid anatomists. 4. *Venereal warts*, met with on the genitals as the result of the irritation of gonorrhœal or other irritant discharges. 5. *Soot warts*, which affect the scrotum of chimney-sweeps, and are so frequently the starting point of "sweep's cancer." 6. *Congenital warts*. which take more the form of irregularly-shaped growths than of true warts, are not very common. *Treatment.*—*Common warts* often disappear spontaneously. They may be readily destroyed by such caustics as salicylic, acetic, and nitric acid, or nitrate of silver; or they may be snipped off with the knife or scissors, or ligatured. *Senile warts*, when large, had better be excised. The *soot wart* ought to be removed at once by the knife. The acid nitrate of mercury is highly spoken of as an application to *verrucæ necrogenicæ.*

CLAVUS.—Corns consist of localized thickenings of the epidermis, and although they may occur on any part of the body that has been subjected to intermittent pressure, are most common on the feet, where they are produced by tight or badly-fitting boots, especially where high heels have been worn, and the weight of the body has thus been unnaturally thrown upon the toes. Two varieties are described, the *hard*, occurring on exposed parts, particularly the dorsum of the toes, and the *soft*, situated between the toes, where in addition to pressure, the parts are subjected to moisture. A hard corn, on section, is seen to be more or less conical; and it is the pressure of the apex of this cone upon the papillary layer of the corium that causes the pain. At times a bursa is developed beneath the corn. At other times suppuration occurs, and the pus being prevented from escaping by the hardened cuticle, gives rise to great tension, pain, and consequent inflammation of the skin and subcutaneous tissue around, and may even terminate in ulceration, which may extend deeply into the foot. *Treatment.*—A hard corn should be pared down, and then painted night and morning with salicylic acid and collodion. In the meantime all pressure should be removed by means of a corn pad, or a hollow moulded in the leather of the boot. Soft corns should be allowed to become dry and hard by separating the toes by cotton-wool, and dusting them with a mixture of oxide of zinc and iodoform, or other form of astringent and antiseptic powder, and then treated in the same manner as hard corns. Should suppuration occur beneath a corn, an incision through it to evacuate the pus will give immediate relief.

CHILBLAINS are local congestions of the skin caused by exposure to cold and damp in young persons with a feeble circulation. They commonly occur on the fingers and toes; less frequently on the nose and ears. They present a sharply-defined, bluish-red blush of erythema, disappearing on pressure, and slowly returning. In severe cases the skin becomes dusky and purplish in colour, and the cuticle gives way, leaving a raw surface (*broken chilblains*). They are attended with intolerable itching. *Treatment.*—The general circulation should be promoted by exercise and good food, and the local by stimulating liniments, the parts being kept warm by woollen gloves or socks. When the chilblain is broken, it may be dusted with iodoform, or dressed with oxide of zinc or soap-plaster. Arsenic internally appears sometimes of service.

ONYCHIA, or ONYCHIA MALIGNA as in severe cases it is sometimes called, is a chronic unhealthy inflammation of the matrix of the nail, attended with ulceration and a fœtid purulent discharge. It is most frequently met with in strumous children as the result of a crush of the finger or some slight injury; but it may depend on syphilis, or more rarely on eczema or psoriasis of the matrix, or its inoculation with the parasite of ringworm. In a typical case the end of the affected finger is swollen and inflamed and of a dusky or livid red colour, whilst the nail is blackened, shrunken, loosened from its matrix, surrounded by a crescent of unhealthy ulceration, and bathed in a very fœtid discharge. It is exquisitely tender to the touch. In severe cases the ulceration may extend to the bone and neighbouring joint, and the last phalanx be lost. *Treatment.*—The nail, if black and shrivelled, should be removed by forceps, the wound powdered with iodoform or nitrate of lead, or dressed frequently with a lotion of liquor arsenicalis or nitrate of silver. In strumous subjects appropriate constitutional remedies must be given. If there is a suspicion of constitutional syphilis, the part should be dusted with calomel, or dressed with blackwash, and mercury or iodide of potassium given internally. In some inveterate cases it may be necessary to scrape or shave away the matrix or destroy it with caustics.

FURUNCULUS, or BOIL.—A boil is a circumscribed inflammation of the skin and subcutaneous tissue, terminating in gangrene of the central part, which is then cast off in the form of a slough, popularly called the core. Boils generally occur in crops, one coming out after the other has healed; or several small boils form around a larger central one. They are usually situated on the neck, nates, back of the hand, and back. Though most common in the young, they may occur at all ages. The *causes* are numerous. As predisposing may be mentioned change of habit, a too exclusively meat diet, diabetes, albuminuria, alterations in the blood depending on acute disease, the emanations of sewer gas, change of season or air, and cachectic conditions however induced. The exciting cause is any local irritation, such as chafing of the neck by the collar, or of the nates in rowing, the irritation of morbid fluids in making *post-mortem* examinations, &c. But frequently no efficient cause, either constitutional or exciting, can be discovered. A micrococcus, which is always present in boils, is thought by many to be the essential cause. *Signs.*—A boil begins as a red pimple usually with a hair in the centre, and as it increases in size forms a painful, dusky, purplish-red and conical swelling, with a flattened apex. The inflammation may at times subside, and the boil gradually disappear (*blind boil*). More often the cuticle separates at the apex, a vesicle forms, bursts, and leaves a yellow slough exposed, which is cast off as a central core through a single opening. *Treatment.*—A boil may sometimes be absorbed by plucking out the central hair, injecting with carbolic acid, applying nitrate of silver, or painting it over with a thick layer of collodion. Should these fail, a linseed-meal poultice or hot fomentations, and, where there is much pain, glycerine and belladonna may be applied, and after it has broken, a simple healing ointment. An incision may occasionally be necessary. The constitutional treatment consists in attention to hygiene, regulation of the diet and secretions, administration of tonics, &c. Arsenic and sulphide of calcium have at times been found useful.

CARBUNCLE is a specific spreading inflammation of the subcutaneous tissue involving, to some extent, the overlying skin and terminating in gangrene of the affected tissue, which is discharged in the form of sloughs. It differs from a boil in that it is of larger size, has a tendency to spread, and is flattened instead of conical; there is greater brawniness of the surrounding tissues; the skin gives way at several places instead of at the apex; the gangrenous tissue is discharged in the form of sloughs instead of as a core; and it is accompanied by severe constitutional symptoms. *Cause.*—Any vitiated state of the constitution, such as may be induced by too high or too poor living, gout, diabetes, albuminuria, typhus or other acute fevers, prolonged lactation, and the like. Friction or pressure are mentioned as exciting causes, and are said to explain the frequency of its occurrence on the nape of the neck, back, and nates. It is more common in men than in women, and does not usually occur till after the middle period of life. It is especially dangerous when associated with diabetes, and when it occurs on the face and scalp. In the former situation, suppurative phlebitis of the angular vein, with extension of the infective thrombi through the ophthalmic vein to the cavernous and other blood sinuses in the skull, and consequent meningitis or general blood-poisoning, is the danger to be apprehended. *Symptoms.*—It begins as a hard painful swelling, accompanied by fever, generally of a low type and with marked depression. The swelling rapidly spreads, and forms a flattened, generally more or less circular, elevation of the skin, surrounded by considerable brawny induration and redness. At first red, it soon becomes purplish-red, dusky or livid. Vesicles form over its surface, and on bursting, leave a number of apertures in the skin through which a greyish-yellow slough is seen. The apertures then coalesce, and the slough is gradually thrown off, leaving a granulating wound; or the inflammation continues to spread, and the patient may sink into a low typhoid or delirious state, and die of asthenia or of blood-poisoning (sapræmia, septicæmia, or pyæmia). *Treatment.*—The strength must be supported by fluid nourishment, and stimulants as indicated by the pulse and temperature; the patient should have abundance of fresh air, and should not, if it can be avoided, keep his bed. Opium should be given when there is much pain. Locally, a crucial incision was formerly a favourite practice, but it is attended with so much hæmorrhage that unless the patient's powers are good it should not be made. Some recommend the introduction of potassa fusa or the injection of carbolic acid into the carbuncle, and speak highly of both plans as a method of arresting its progress while still small. Others apply strapping firmly over it, leaving an aperture for the escape of the discharge through the centre. Others again make a subcutaneous incision when there is much pain and tension; whilst by the majority of surgeons the expectant treatment of merely poulticing is followed. Poultices are open to the objection that they tend to produce putrefaction of the sloughs, and as their chief use is the application of heat and moisture, a better substitute is some hot antiseptic lotion, or spongiopiline steeped in hot antiseptics. Recently scraping away the sloughs and diseased tissues by a Volkmann's spoon has been recommended for preventing septic poisoning and promoting healing. When the sloughs have separated or have been removed, the wound should be treated as a granulating ulcer, but as it is often slow in healing it may require stimulation with resin ointment, Peruvian balsam, &c.

LUPUS VULGARIS is a disease of childhood, and seldom begins after the age of puberty. It is characterized by the formation of yellowish-red nodules in the skin or mucous membrane, and subsequently by scarring and often great destruction of the affected tissues and much deformity. The *cause* is unknown, but it is believed by many to be of the nature of a local tuberculosis depending on the presence of the tubercle bacillus. *Pathology.*—The deeper layers of the corium become infiltrated with small round cells, amongst which new capillaries are formed. In this granulation-like tissue are found non-vascular areas resembling in structure miliary tubercles, and in them the tubercle bacillus has at times been discovered. The small-cell infiltration extends along the vessels, sweat-glands, sebaceous glands and hair-follicles, and may finally involve the whole of the corium. The granulation-like tissue may then either undergo atrophy and be partially absorbed without ulceration, though leaving, nevertheless, a permanent scar (*Lupus non-exedens*); or it may undergo caseation, and, the cuticle giving way, break down into an ulcer (*Lupus exedens*).

Signs.—The disease begins as reddish or amber-coloured, semi-transparent, jelly-like nodules, the colour of which does not completely disappear on pressure. The nodules later become slightly elevated, and several coalesce, forming larger nodules or tubercles, over which the cuticle forms slight scales. In the *non-exedens* variety the centre of the patch undergoes atrophy and partial absorption, leaving a slightly-depressed whitish cicatrix. In this way the disease may become cured; or while cicatrization is taking place in the centre the disease may continue to spread at the margins. In *lupus exedens*, the lupous patch breaks down and ulcerates, the surrounding skin often becoming inflamed. The edges of the ulcer are raised, whilst its base is smooth, red, and spongy-looking. The ulceration may proceed gradually or rapidly, and extend through the skin or mucous membrane to the underlying structures, destroying, as when the nose is attacked, skin, mucous membrane, muscle, cartilage, in fact everything except bone. The favourite seat of lupus vulgaris is the face, especially the ala of the nose; but it may attack the skin and mucous membrane of almost any part. It is more common in females than in males. From tubercular syphilis, the affection for which it is perhaps most likely to be mistaken, it may be distinguished by the age at which it began, the history of the case, and the absence of concomitant signs of syphilis.

Treatment.—The lupous patch should be thoroughly scraped with a Volkmann's spoon, the scraping being continued as long as any soft lupoid material comes away, and until the tissues feel hard and resisting to the spoon. The actual cautery, or some form of caustic, is then by some applied to the raw surface, but it is not necessary. The wound should be dressed with iodoform or other antiseptic, and healing is quickly accomplished with comparatively little scarring. Internally, cod-liver oil, arsenic, or the phosphate or the iodide of iron, may generally be given with advantage.

LUPUS ERYTHEMATOSUS is a chronic inflammation of the sebaceous follicles and surrounding connective tissue. *Pathology.*—The capillaries of the follicles become dilated, and the tissues infiltrated with small round cells. The follicles then become enlarged and distended with sebaceous material, which exudes and forms greasy scales on the surface of the lupous patch. These scales, on removal, are found continuous with the plugs of sebaceous material filling the follicles. Later, the follicles are destroyed, and the infiltrating cells converted into cicatricial fibrous tissue. The *cause* is unknown, but it is believed to depend neither on syphilis nor on tubercle. It has not been proved to be hereditary, and it is not contagious. *Signs.*—It begins most commonly on the cheeks or nose in the form of one or more erythema-like red patches, which fade momentarily on pressure, and are often attended with itching. The patches become covered with greasy scales continuous with the sebaceous matter in the enlarged follicles. They usually spread by their slightly raised edges, leaving dry, pale, depressed scars in their centre, which are productive of considerable deformity, but ulceration does not occur. The disease is nearly always symmetrical, affects most commonly the cheeks and nose, less commonly the ears, scalp, lips, backs of the hands and fingers, and after an apparent cure is liable to a relapse. It is most frequent in women, begins in young adult life, is very chronic in its course, and is often complicated by attacks of erysipelas. *Treatment.*—The general health should be attended to, and arsenic, cod-liver oil, or iron should be given if indicated. Local treatment, however, is the only efficient means. Very numerous applications for relieving the itching and promoting absorption have been recommended, such as mercurial plaster, iodine, and oleate of zinc; but the best method is linear scarification, which must be repeated from time to time for considerable periods.

INGROWING NAIL is most frequently met with in the great toe as the result of wearing tight boots and of cutting the nail square. The tight boot presses the skin over the sharp corner of the nail on each side, and ulceration, attended by the formation of exquisitely tender and exuberant granulations, results, giving the part the appearance as if the nail had grown into the flesh. The condition is a very painful one, and troublesome to cure. The *treatment* consists in wearing square-toed boots, so as to provide plenty of room for the toes, and then pressing a piece of tinfoil or lint between the edge of the 'ingrowing' nail and the overhanging portion of skin. Should this not succeed a longitudinal strip of nail should be removed, and the prominent granulations and redundant skin shaved away to the level of the nail, together with that portion of the matrix corresponding to the strip of nail removed. As the operation is excessively painful, it should be done under an anæsthetic; or the ether spray may be used, or the part painted with cocaine.

HYPERTROPHY of the toe-nail occasionally occurs as the result of neglect or chronic congestion of the matrix, and may assume the form of a horn. The *treatment* consists in cutting away the hypertrophied portion or in removing the whole nail.

SECTION V.

Injuries of Regions.

INJURIES OF THE HEAD.

Injuries of the Scalp.

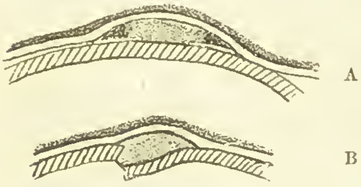


Fig. 84.—A. Section of a cephalhæmatoma ; and B. a depressed fracture. The dark shading in A. represents the coagulated blood.

Contusions of the scalp are very common as the result of falls or blows on the head, and are frequently followed, especially in children, by extravasation of blood, and the consequent formation of a *hæmatoma* or blood-tumour. In new-born infants such tumours are of frequent occurrence in consequence of severe pressure on the head during birth, especially when instruments have been used, and are then known as *cephalhæmatomata.* The blood may be extravasated (1) between the aponeurosis and the pericranium; and (2) between the pericranium and the bone. In the latter situation the resulting tumour is generally circumscribed ; in the former it is generally diffuse, and in some instances extends over the whole of one side of the head. The diffuse form can only be mistaken for an abscess, from which, however, it may be distinguished by its sudden formation and the absence of signs of inflammation. The circumscribed, which gives rise to a soft fluctuating tumour with hard and often sharp margins, is sometimes very difficult to diagnose from a depressed fracture. In the case of the blood-tumour the hard margins (which are due to the coagulation of the blood at the circumference—the central part remaining fluid) are raised above the level of the surrounding bone, as may be detected by passing the finger along the scalp; while on pressing upon them with the finger-nail the blood may be displaced and the bone be felt beneath. As a rule, the blood becomes absorbed, but ossification at times occurs in the angle where the pericranium is raised from the bone. *Treatment.*—Under the use of evaporating lotions the more superficial hæmatomata will usually subside. It may sometimes be necessary, however, to aspirate those more deeply situated. If suppuration occurs a free incision should be made.

WOUNDS OF THE SCALP vary in extent from a mere scratch to an extensive denudation of the bone, and, like other wounds, may be incised, lacerated, punctured, or contused. Though large portions of the scalp may be torn up from the bone, sloughing is very rare, as the arteries which supply the scalp run between the skin and the aponeurosis, and hence are contained in the flap. Scalp-wounds are frequently attended with sharp hæmorrhage; they are also often associated with fracture of the skull, search for which should always be made by passing the finger into the wound. Moreover, they are apt to be complicated by erysipelas or cellulitis with the formation of pus between the aponeurosis and the pericranium, and, where the bone has been much contused, by suppuration beneath the pericranium, in the diploë, or between the bone and dura mater. Suppuration in any of these three situations may be followed by necrosis of the bone, by septicæmia or pyæmia, or by inflammation of the brain and its membranes. When a flap of the scalp has been completely detached, and even when the pericranium has also been lost, necrosis need not necessarily occur, since granulations may spring up from the bone, and cicatrization follow.

Treatment.—The scalp should be shaved around the wound, and the latter cleansed, if necessary, with antiseptics, dusted with iodoform, and, if small and incised, closed with adhesive strapping and supported by a capeline or other form of bandage. When large portions of the scalp have been stripped up but not detached, the flaps should be carefully replaced, and secured by silver sutures. Hæmorrhage is usually readily controlled by pressure, though occasionally it may be necessary to completely divide a partially torn artery or to apply a ligature. If the wound is extensive the patient should be kept at rest for a few days, placed on low diet, a smart purge given, and a careful watch made for signs of suppuration. Should such occur, the adhering margins of the wound should be separated to permit the free escape of the pus, and the wound be allowed to heal by granulations. If pus forms at some distance from the wound, an incision must be made at that spot through the scalp, of course avoiding the track of any large vessel.

Injuries of the Cranial Bones.

CONTUSIONS OF THE CRANIAL BONES are always serious, especially when attended with a wound of the scalp, inasmuch as they are liable to be followed by—1. Inflammation of the pericranium, which may terminate in suppuration between it and the bone and necrosis of the external table or even of the whole thickness of the skull; 2. Suppuration in the diploë, with implication of the large diploic veins, and probably septicæmia or pyæmia; 3. Suppuration between the bone and dura mater, and subsequent general meningitis; 4. Chronic inflammatory thickening of the cranial bones or dura mater, giving rise to constant headache, impairment of one of the special senses, epilepsy, or even insanity; and 5. Cerebral abscess.

Signs.—Contusions of the skull are attended by no primary symptoms, but should any of the above-mentioned conditions supervene there will be the usual signs of inflammation localized to the injured spot, with more or less constitutional disturbance. 1. In simple pericranial inflammation the symptoms will usually subside in a few days. 2. Should pus form between the pericranium and the bone, there may be chills, and perhaps rigors, with local signs of suppuration; whilst the bone, should necrosis occur, will become dry and yellowish-brown or greenish-white in colour. 3. Should suppuration ensue in the diploë, there will be rigors, followed by high temperature, and probably, later, signs of pyæmia or septicæmia. 4. Pus between the bone and dura mater will be indicated by headache, vomiting, rigors, monoplegia or hemiplegia, delirium, or stupor, followed by convulsions or coma (see *intracranial suppuration*); whilst locally a circumscribed swelling may form over the injured spot (*Pott's puffy tumour*), or if there is a wound it will become dry and the bone discoloured.

Treatment.—When, from the account of the injury, it is probable that the bone has been contused, measures should be taken to prevent inflammation by rest, cold to the head, free purging, and, where there is a wound, by strict antiseptic precautions. Should suppuration be suspected between the pericranium and the bone, free incisions to let out the pus should at once be made; whilst should the signs point to the formation of pus between the bone and dura mater, the trephine should be applied. For suppuration in the diploë, and the consequent septicæmia and pyæmia, little or nothing can be done.

FRACTURES OF THE BONES OF THE SKULL may be divided into—1. Fractures of the vault; and 2. Fractures of the base.

1. FRACTURES OF THE VAULT.—*Causes.*—Generally *direct* violence, as a blow on the head with a sharp-pointed body, or fall on a sharp edge. (Blows with soft bodies or falls on soft ground on the head more often cause a fracture of the base, or a fissured fracture extending over the vault to the base.) Occasionally *indirect* violence, as a blow, say on the front of the head, causing a fracture at the back (*fracture by contrecoup*).

Varieties.—The fracture may take the form of a simple fissure (*fissured fracture*), or of several fissures radiating in various directions (*stellate or radiated fracture*); or the skull at the seat of injury may be broken into several pieces (*comminuted fracture*), one or more of which may be pressed inwards below the surface of the rest of the bone (*depressed fracture*); or a portion of bone in rare instances, as in some forms of sabre-wounds, may be raised above the surface of the skull (*elevated fracture*). At times the fracture consists of a mere puncture of the bone, with driving inwards into the membranes or brain of the sharp fragments of the inner table (*punctured fracture*); and, lastly, the fracture may be limited either to the outer or to the inner table of the skull (*partial fracture*). In any of these varieties, except, perhaps, in the punctured, the scalp may remain whole, when the fracture, as in other situations, is said to be *simple;* or there may be a wound of the scalp leading to the fracture, when it is said to be *compound.* In children the bone may be depressed without fracture.

State of the parts.—In *simple fissure* there is no displacement of the bone, but a mere crack extending from the part struck for a variable distance over the vault, and frequently running through the base of the skull. In the *stellate fracture* several fissures radiate over the vault from a central point, at which the bone is frequently punctured.

The *comminuted fracture* is generally compound, and one or more of the fragments may be completely detached or driven through the dura mater into the brain, which itself may protrude through the external wound. In the *depressed fracture* the depressed fragments may be loose, or firmly locked together, often forming a shallow or deep rounded or oval depression,—*pond* and *gutter* fractures, as they are sometimes called (Fig. 85). *Elevated fractures* (Fig. 86) are not often met with in civil practice.

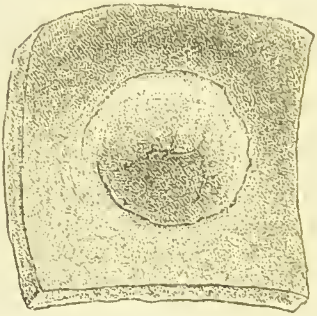


Fig. 85.—Depressed fracture (pond variety).
(St. Bartholomew's Hospital Museum.)

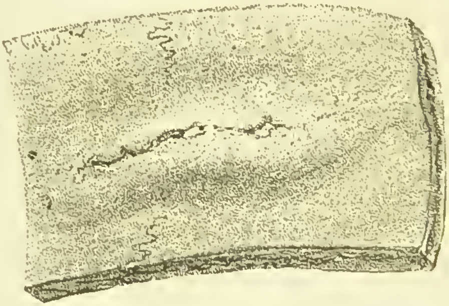


Fig. 86.—Elevated fracture, probably from the cut of a sabre.
(St. Bartholomew's Hospital Museum.)

They are the result of oblique cuts, as by a sabre, and only occur in young adults whilst the bone is comparatively soft. In *punctured fractures* (Fig. 87), which are generally produced by a blow with a sharp instrument, as a pick-axe, or a fragment of a falling chimney-pot, or by a fall on a spike, &c., the splinters of the internal table are often driven into the dura mater or brain at right angles to the rest of the bone. When the membranes are not injured at the time of the accident, the irritation of these sharp fragments, if not removed, is nearly certain to set up meningitis. At times the inflicting body has been found broken off flush with the surface of the skull. Fracture of the *external table* alone is most common over the frontal sinuses, where it is separated for some distance from the internal. In fracture of the *internal table* (Fig. 88), which is a rare accident, there may be merely a splintering of the bone, or a fragment may be completely detached or driven into the dura mater or brain. Any of these fractures may be complicated by laceration or other

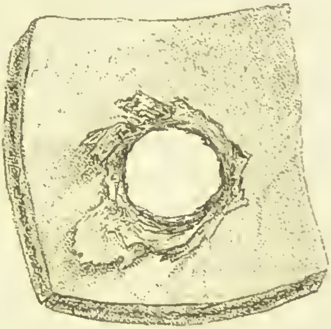


Fig. 87.—Punctured fracture.
(St. Bartholomew's Hospital Museum.)

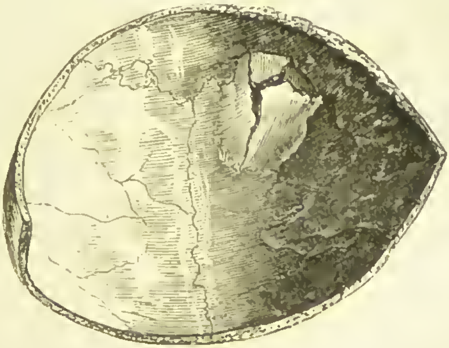


Fig. 88.—Fracture of the internal table.
(Druitt's Surgery.)

injury of the brain or its membranes, or by rupture of the middle meningeal artery or of one of the venous sinuses. In all fractures involving both tables, except in the simple fissure, there is usually greater splintering of the internal than of the external table. In fractures, however, produced from within the cranium, as by a bullet passing through the skull, the external table at the aperture of exit is more splintered than the internal. The reason for the greater splintering of the internal table (or the external table when fractured from within) is, that the force is broken in perforating the external table, and becomes more distributed over the internal. It was formerly said to be due to the internal table being more brittle than the external.

Signs.—Whatever the form of fracture, it may be accompanied by signs of concussion, compression, or other injury of the brain. Here only are given the principal local signs of the various forms of fracture of the vault. In a *simple fissured fracture* there are no signs, but in the *compound variety* the fissure may be detected by the finger in the wound. A sharp edge of the torn pericranium, a suture, or a natural inequality may, however, if care is not exercised, be mistaken for such a fissure. In the *depressed fracture* the depression in the bone in the *simple* variety may be obscured by extravasated blood, either in the scalp or under the pericranium, but in the *compound* variety it can be felt by the finger and, if the wound is large, seen. In both varieties, when the bone is much depressed, signs of local compression of the brain may be present. In the *punctured fracture* the sharp fragments may be detected, with the finger or with a probe, projecting into the interior of the cranium, and signs of local compression may or may not be present; later, symptoms of inflammation of the brain, if the fragments are not removed, will almost certainly supervene. In both the compound depressed and punctured fracture there may be comminution or loss of bone, and portions of lacerated brain substance may at times exude through the fracture. *Fracture of the inner table* is very difficult to diagnose, but later it may be indicated by an increase of local temperature, signs of local compression and localized pain from irritation of the dura mater. It is said that a friction sound may sometimes be heard, from the rubbing of the brain and pia mater on the sharp fragments. When a fracture is situated over the frontal sinuses there may be emphysema from escape of air into the connective tissue, or if the fracture is compound air may be forced out of the wound on blowing the nose.

The *treatment* of fracture of the vault will necessarily vary according to the nature of the fracture and of any cerebral complications that may be present. The general indications are to prevent inflammation of the brain and its membranes, and to relieve any existing brain complication. Thus the patient should be placed at perfect rest in a darkened room, every source of cerebral irritation avoided, an ice-bag applied to the shaven head, the bowels acted on by a calomel purge, and the diet restricted to slops. When the fracture is compound every care should be taken to render the wound aseptic, and to promote healing by the first intention. 1. In *fissured* fracture, uncomplicated by cerebral mischief, little more will be required; but when symptoms of cerebral compression are present the question of trephining may be raised, and will turn upon the probable nature of the cerebral lesion (see *Compression of Brain*). 2. In *depressed* fracture the treatment will differ according as the fracture is simple or compound, and according as symptoms of local compression of the brain are or are not present. In the *simple* form, unless the depression is deep and there are signs of local compression, no operative interference should be undertaken. In the *compound* form, any fragment found loose or penetrating the membranes of the brain should be removed, or if slightly depressed, raised, provided the elevator can be readily inserted beneath it. If a fragment is deeply depressed and cannot be raised by the elevator the trephine had better be applied. When, however, the depression is but slight, and the fragments are interlocked, as in *pond* and *gutter* fractures, the case, unless there are signs of local compression of the brain, should, as a rule, be left to nature. The patient, however, should be carefully watched lest inflammation supervene, on the first signs of which the depressed bone should be removed by the aid of the trephine. In both the simple and compound varieties the depressed bone, if it is apparently causing compression of the brain, must be raised by the elevator or by means of the trephine.

It may here be remarked that some Surgeons recommend the raising of the depressed fragments under nearly all circumstances, even when there is no external wound; as although many cases of depressed fracture undoubtedly recover, nevertheless, inflammation of the brain and its membranes, or if this danger is escaped, subsequent trouble, such as long-continued headache, progressive mental inability, or even epilepsy and insanity, may ensue from the irritation of the depressed bone. In *punctured* fracture the trephine should always be applied, as here the fragments are driven vertically inwards (see Fig. 87), and though they may not have punctured the dura mater, will invariably set up inflammation if not removed. In fracture of the *internal table*, too, the trephine ought to be applied; but this form of fracture is seldom diagnosed.

After any kind of fracture the patient ought to be carefully watched for a month or six weeks, and although no complications are present at first, the greatest care should be exercised, and any indiscretion in diet, abuse of stimulants, or undue mental excitement should be avoided.

2. Fracture of the base is generally caused by a blow or fall upon the vault, the fissure extending from the part struck to the base; or it may be due to a fall upon the feet or nates, the fracture being then produced by the shock transmitted to the occipital bone through the spine. Rarely it has been caused by a sharp instrument, as a sword thrust through the roof of the orbit or nose, or by a blow on the lower jaw fracturing the glenoid cavity or forcing the condyle through it. As a rule the anterior, middle or posterior fossa is found fractured, according as the blow falls upon the anterior, middle, or posterior part of the vault of the skull. Should the force however be very severe, fissures may radiate from the seat of injury to two, or even to all three fossæ. Fractures through the middle fossa generally involve the petrous portion of the temporal bone on one or both sides of the skull. Thus they frequently extend through the internal and external auditory meatus and walls of the tympanum, lacerating the prolongation of dura mater contained in the internal auditory meatus, the reflexion of the arachnoid around the seventh pair of nerves, and the membrana tympani, and so allow of the escape of the cerebro-spinal fluid from the external auditory meatus. The fracture may also involve the lateral sinus or middle meningeal artery, in which case blood may be found mixed with the cerebro-spinal fluid that escapes from the ear. Fracture of the posterior fossa extends through the foramen magnum of the occipital

bone, and frequently through the petrous portion of the temporal bones. Fracture of the anterior fossa involves the roof of the orbit and nose. One or more of the nerves that escape through the bony foramina in the base of the skull, the lateral sinus, the middle meningeal artery, or one of the smaller blood-channels are frequently torn or otherwise injured in a fracture of the base; whilst the inferior lobes of the brain are often extensively lacerated and contused, or compressed by extravasated blood. It should be remembered that a fracture of the base, if the membrana tympani or the mucous membrane covering the cribriform plate of the ethmoid bone is ruptured, is really of the nature of a compound fracture, and hence is liable to be followed by septic inflammation, which, moreover, may spread to the membranes and brain.

Signs.—At times there may be none, and the nature of the injury may be quite overlooked. Generally, however, symptoms, such as compression, indicative of a severe lesion of the brain co-exist, and these, together with the history of tho way in which the injury occurred, should lead us to suspect that the base is fractured. The signs, however, which when present may be considered diagnostic of the injury are—1. The escape of cerebro-spinal fluid from the ear, nose, or mouth, or from a wound if one exists. 2. The escape of blood from similar situations. 3. Effusion of blood under the conjunctiva, about the mastoid process, or in the sub-occipital region; and 4. Injury of one or more of the cranial nerves.

1. Cerebro-spinal fluid consists principally of water holding in solution a large amount of chloride of sodium. It has a low specific gravity (1002), and contains little or no albumen, but sometimes a trace of sugar. When it escapes in considerable quantities (several pints in the twenty-four hours) immediately after an injury, it is pathognomonic of fracture of the base. Escaping from the ear, it indicates fracture of the middle or posterior fossa; from the nose or mouth, generally the anterior fossa, though in fracture of the middle or posterior fossa it may, by passing along tho Eustachian tube, or through a fracture of tho basilar process with laceration of the mucous membrane of tho pharyngeal vault, also come from the nose or mouth.

2. Blood may escape from tho same parts and by the same channels but has not the like diagnostic value, since bleeding from tho ear, and especially from the nose,

may occur from causes other than fracture. Still when blood escapes in considerable quantities, and for some time after the injury, it is when combined with other evidence of severe cerebral mischief a sign of importance. It should not be forgotten that blood coming from the nose or roof of the pharynx may be swallowed and afterwards vomited or passed by the bowel.

3. Effusion of blood under the ocular conjunctiva, and ecchymosis about the mastoid process and sub-occipital region, are signs of less value; the former may indicate fracture of the anterior, and the latter fracture of the posterior fossa, the blood passing along the floor of the orbit in the one case to the conjunctiva, and in the other draining through the fracture and appearing under the skin.

4. Injury to one or more of the cranial nerves will be indicated by paralysis, loss of function, or spasm of the parts which they supply. Thus there may be dropping of the upper eyelid (*ptosis*), external squint, and dilatation of the pupil, when the third nerve is affected; deafness or loss of sight if the auditory or optic is injured, &c., but as the patient is frequently comatose these signs may not afford much information.

The *prognosis* is always grave, the lesion generally, though not invariably, terminating fatally from concomitant injury to the brain, or from septic inflammation of the brain and its membranes.

The *treatment* should be directed towards the prevention of inflammation of the brain, in the way described under fracture of the vault (p. 335). It has been suggested that when the membrana tympani is ruptured, an attempt may be made to prevent putrefactive changes, and consequently septic inflammation, by syringing out the ear with carbolic lotion, dusting it with iodoform, and applying an antiseptic dressing. It is true that even when this is done a way still remains open to the tympanum by the Eustachian tube; but it is thought that the cilia prevent the access of air by this channel. Should intracranial inflammation supervene, it must be treated in the way indicated under that head (p. 348).

Injuries of the Brain and its Membrane.

CONCUSSION OF THE BRAIN.—This term is applied to a collection of symptoms supposed to depend on a shaking or commotion of the brain substance. It is popularly spoken of as '*stunning*.'

Pathology.—The exact condition of the brain that gives rise to the symptoms which go by the name of concussion is not known. By some it is believed that they depend on the mere shock to the brain—that there is some vibration or molecular disturbance of its particles, or anæmia of its substance induced by spasm of the small arteries, and that the shock may prove fatal in this way without any lesion being discovered after death. Generally, however, a slight contusion or laceration of the brain, or punctiform extravasations of blood in its substance have been found, and to such some attribute the symptoms of concussion. In the few cases that have been immediately fatal after a blow on the head without any obvious lesion having been discovered in the brain, the *post-mortem* examination has been unfortunately incomplete. Hence it is maintained by those who hold that there is always an obvious lesion, that death in these cases might have resulted from other mischief, such as fracture of the cervical spine.

Symptoms.—Concussion may be divided into two stages: 1. Insensibility; 2, Reaction. 1. *The first stage* comes on immediately on the receipt of injury; it may be quite transitory, the patient merely losing consciousness for a few minutes, and then recovering completely; or it may last for a few hours or a few days or even longer. The patient lies in an unconscious condition, but can be roused momentarily on shaking him, or shouting in his ear. There is loss of all power of motion; the pulse is feeble, fluttering, often frequent; the respirations are shallow, and quiet or sighing; and the surface is cold, often clammy, the temperature sometimes being as low as 97 or 96. The pupils are variable, but sensitive to light. The sphincters are often relaxed at the time of injury, allowing the involuntary passage of the fæces and urine, but are not paralysed. This condition, after lasting for a variable time, usually passes gradually into the second stage—that of reaction; or symptoms of compression or of inflammation of the brain may come on without the patient recovering consciousness. 2. *The second stage*, or that of *reaction*, is marked by a gradual return to consciousness, and is usually preceded by vomiting which is therefore regarded as a favourable omen. The skin becomes warm, the pulse increased in frequency, and the temperature slightly raised. These symptoms commonly terminate in complete convalescence, or they may run into those of inflammation of the brain. At times, however, the patient may relapse into a state of unconsciousness and die, or certain impairments of brain function may remain.

The *remote effects* of concussion may be enumerated as headache, confusion of thought, mental irritability, impaired virility, epilepsy, or even insanity. These after-effects are more likely to occur if there is an inherited predisposition to nervous diseases, and appear to be brought on by excitement, abuse of stimulants, or excess of diet. In some of these cases the brain has been examined after death, but no organic lesion has been found.

Treatment.—The chief indication is to restore the cerebral functions by promoting the cerebral circulation, taking care not to produce too violent a reaction. Thus the patient should be placed at perfect rest; warmth applied to the surface by means of blankets, hot bottles, and, if necessary, by friction; and small quantities of diffusible stimulants, as ammonia or warm tea, administered. Alcohol should not as a rule be given. When reaction has come on, inflammation must be warded off by gentle purgatives, low diet, and the avoidance of stimulants and of mental exertion.

COMPRESSION OF THE BRAIN may be caused by: 1. A fragment of depressed bone; 2. Extravasated blood: 3. Pus, or other inflammatory products; and 4. Foreign bodies, such as a bullet.

The *signs* of compression, *i.e.*, of pressure on the brain, vary according as the compression is made over a wide area or is localized to a particular part. Thus, when the pressure is *diffused* over a considerable portion of the brain, the patient lies in a completely unconscious state, and cannot be roused either on shouting in his ear or on shaking him. The extremities on one or both sides are paralysed; the face is livid, at times flushed; the temperature is usually low, but at times raised; the pulse is full and slow, often not beating more than 40 to the minute; the respiration is slow, laboured, and stertorous, *i.e.*, a peculiar noise is made during expiration by the flapping of the paralysed soft palate; the lips and cheeks puff out at each expiration in consequence of paralysis of the buccinator and muscles of the lips; the pupils are fixed (*i e.*, the iris does not respond to light), and may be either dilated or contracted, or one may be dilated and the other contracted; the urine is at first retained owing to the paralysis of the muscular coat of the bladder, but afterwards dribbles away as the bladder becomes over-distended; the fæces pass involuntarily; at times there are violent convulsions. When on the other hand the pressure is *localized* the coma is usually less profound, the pupil on one side only may be fixed and the paralysis may be limited to one side, possibly to an arm or leg, or to one side of the face or there may be convulsive twitching of certain muscles or of a limb. The compression-symptoms may gradually deepen till the patient dies; or he may recover on the removal of the cause, *e.g.*, a piece of bone or a clot of blood.

The *diagnosis of the cause of the compression* will rest on the fact that when due to bone or blood the symptoms come on within twenty-four hours of the injury, generally directly if due to bone, or after a brief interval of consciousness if due to blood; but not till three or four days after the injury if due to the pressure of inflammatory exudation or of pus, in which case, moreover, they are preceded by signs of inflammation. Where the signs are general, as given above, the injury usually depends upon the pressure of extravasated blood on some of the central portions of the brain following upon laceration of the brain-substance, or upon general inflammation of the brain or its membranes. But when the signs are those of local pressure on the surface of the brain, the lesion will probably be due to a depressed portion of bone or a circumscribed extravasation of blood between the bone and dura mater, or a collection of pus either between the bone and dura mater or in the cortical substance of the brain.

The *treatment* will necessarily depend upon the cause of the compression. Thus a depressed fragment of bone should be removed (see *depressed fracture*), a clot between the bone and dura mater let out by the trephine, and a circumscribed collection of pus between the bone and dura mater, or in the membranes or brain, also evacuated by the trephine. But when the compression depends upon extravasated blood in the subdural or subarachnoid space or substance of the brain, or upon a general inflammation of the brain and its membranes, no surgical procedure is of any avail. In any case, therefore, the first point to consider in regard to treatment is, whether the compression of the brain is due to a removable cause, or to one that is beyond the reach of surgery.

EXTRAVASATION OF BLOOD in the cranium may occur 1. Between the bone and dura mater; 2. In the subdural space; 3. In the subarachnoid space; and 4. In the substance of the brain.

1. *Blood between the bone and dura mater* (*subcranial extravasation*) is generally due to rupture of the middle meningeal artery, especially its anterior branch, and is commonly associated with a fissured fracture extending across the line of the artery. At times it is due to a wound of the lateral sinus or a laceration of some of the small vessels which run from the dura mater into the bone. The blood is usually extravasated in large quantities, widely separating the dura mater from the bone, and producing severe compression of the brain. Should the patient survive, the blood may become organized or absorbed.

2. *Subdural extravasation* is due to rupture of capillary vessels, and is very common in severe head injuries. The blood usually extends widely over the surface of the arachnoid, and, if the patient survive, may become absorbed or organized, forming a false membrane, and in some cases a blood-cyst.

3. *Subarachnoid extravasation* is generally associated with contusion or laceration of the brain. The blood may spread widely, and may become absorbed, but does not as rule become organized.

4. *Blood in the brain substance* (*intracerebral extravasation*) is the result of contusion or laceration of the brain, with rupture of the small vessels. When the laceration is extensive, it is usually fatal; but should the patient survive, the blood may undergo changes similar to those of an ordinary apoplectic clot, or may break down into pus (*cerebral abscess*).

The *symptoms* of intracranial extravasation are those of compression of the brain, but vary according to the situation of the blood and the rapidity with which it is extravasated. The diagnosis may be more or less obscured by the presence of concomitant injury to the brain. 1. When the *blood is between the bone and dura mater* the patient, to take a typical case, is concussed at the time of the injury, recovers from the concussion, and is, perhaps, rational, then grows faint and sinks into a state of coma. The coma gradually deepens, and he usually dies in from a few hours to a few days after the injury with signs of profound compression of the brain. The paralysis at first is on the side opposite to the injury, but may become general as the blood extends over the surface of the brain. The pupil on the side of the injury may at first react to light, but becomes dilated and fixed as the blood extends to the base and presses on the third nerve. At times the eyeball may protrude owing to the pressure upon the cavernous sinus. Very occasionally reflex convulsions, also on the side of the injury, may be set up by irritation of the nerves of the dura mater. If a fissured fracture is present, there may be some fulness externally from the escape of blood through the fissure. 2. When the *blood is in the subdural space*, signs of compression may be present; but there are no special symptoms by which it can be diagnosed, or, indeed, at times distinguished from blood between the bone and dura mater. Irritability of temper, headache, or convulsions coming on some time after the injury, are said, however, to indicate it. 3. When the *blood is beneath the arachnoid* in quantities sufficient to cause compression, it will probably be associated with severe laceration of the brain, and the patient will not, as a rule, regain consciousness. There are no special symptoms by which blood in this situation can be diagnosed (see *Laceration of Brain*). 4. When the *blood is in the brain substance* it produces symptoms which cannot be distinguished from those of apoplexy, except perhaps by the history of the injury, and not always then, as it may be impossible to determine whether the patient first fell and thus injured his brain causing effusion of blood into its substance, or whether a vessel first gave way, and the fall was the consequence of the escape of blood into the brain.

Treatment.—When it is clear that the hæmorrhage is from the middle meningeal artery, and it appears probable that no other serious injury of the brain has been received, the trephine should be applied for the purpose of removing the clot and securing the bleeding vessel. The situation of the artery is about an inch and a half behind the external angular process of the orbit, and over this spot a crown of bone should be removed. The dark clot which now protrudes at the opening should be turned out by some form of scoop, and if the bleeding artery is then seen, an attempt should be made to tie or twist it, or to compress it by plugging the groove in the bone in which it lies with a piece of wax or wood. If the bleeding point cannot be reached, more bone may be cut away. If, however, on the removal of the clot, the brain does not expand, and the hæmorrhage is so profuse that the wounded artery cannot be seen, the external or common carotid artery may be compressed or tied, and ice applied to the side of the head. When no blood is found between the bone and dura mater, but the dura mater itself is bluish in colour, does not pulsate with the brain, and bulges into the trephine hole, indicating the presence of blood beneath it, an incision should be made through it and the blood let out. Great care must subsequently be taken to keep the wound aseptic. For hæmorrhage on the surface or in the substance of the brain surgical interference is not permissible; all that can be done is to treat the case as one of ordinary apoplexy from cerebral hæmorrhage, *i.e.*, by free purging, cold to the head, hot bottles to the feet, &c.

CONTUSION OR BRUISING OF THE BRAIN may be due to any severe violence, and may occur with or without injury of the scalp or cranial bones. It is often accompanied by laceration of the brain substance and of the pia mater and arachnoid. The bruising may be general or circumscribed. In the latter case it may occur immediately beneath that part of the cranium to which the violence was applied, or on the opposite part of the brain, the brain being as it were dashed by the violence of the blow against the cranial wall furthest from the part of the skull to which the force was applied. Like bruises of other soft tissues it is attended by extravasation of blood from rupture of the smaller vessels. It may terminate in absorption of the blood and healing of the bruised parts, or in general inflammation of the brain and its membranes, or in local inflammation and cerebral abscess. The *symptoms* are generally obscured by those of concussion or compression, and it is seldom that an accurate diagnosis can be made. Irritability, restlessness, and spasms of certain muscles, when a motor centre is injured, are said, however, to point to contusion. The chief indication for *treatment* is to prevent the occurrence of inflammation of the brain (see p. 335).

LACERATION OF THE BRAIN may occur with or without fracture or other injury of the skull. The laceration is most common in the anterior part of the frontal and in the temporo-sphenoidal lobe, owing in part to the unevenness of the base of the skull on which these lobes rest, and in part to the fact that the back and the top of the head are most exposed to injury, the brain, as in contusion, being generally lacerated on the side of the head directly opposite to that on which the force is received. At times, however, the brain is lacerated directly beneath that part of the skull to which the force is applied. Laceration may also be caused by a fragment of bone, as in depressed or punctured fracture, or by the passage of a bullet or the thrust of a sword through the orbit or nose.

Pathology.—The laceration may be slight or very extensive, and is generally accompanied by more or less bruising of the surrounding brain-tissue and extravasation of blood over its surface. The pia mater is also lacerated, and where the injury is produced by a fragment of bone the dura mater is likewise torn, and in some cases, large portions of the lacerated brain may protrude through the skull. Inflammation of the brain and its membranes is liable to follow, and to assume a septic character and spread widely if there is an external wound which has not been kept aseptic. Should the patient recover, cicatrization, with adhesion of the membranes, occurs, the extravasated blood in the meantime undergoing the changes already described.

The *symptoms* vary. At times there may be none, although a considerable mass of brain-tissue is protruding through a fracture in the skull. Or they may be obscured by signs of concussion, or, if much blood has been extravasated, by those of compression. There are no signs pathognomonic of laceration of the brain, but convulsions, localized spasms or paralysis, long-continued insensibility without coma, and the collection of symptoms known as cerebral irritation, point to such an injury. The symptoms of *cerebral irritation* may be described as follows:—The patient lies in a torpid or semi-conscious condition, coiled up on one side, with his limbs in a general state of flexion. If spoken to he evinces great irritability of temper, answering momentarily and sharply, perhaps shaking himself, and then relapses into his torpid state. His pupils are contracted, his eyes closed, but his pulse, temperature, and respirations are normal. *Is there any way of localizing the seat of the laceration where no external injury exists?* "If a patient receive a blow upon the head, and it is found that localized paralysis is present, we conclude that there exists a laceration of some severity in the cortical centre corresponding to the muscles implicated. If almost immediately after the injury there is a distinct spasm affecting a localized group of muscles—a monospasm—we conclude that hæmorrhage is going on from the lacerated brain substance, or breaking down the tissue of the centre corresponding to the affected muscles. If the monospasm extends, first affecting one side of the body, and finally both sides, so that the attacks assume the form of true epileptic fits, it is probable the extravasated blood is extending over the surface of the brain and irritating more or less widely the whole motor area" (*Erichsen*). Should there be aphasia, a lesion of the posterior extremity of the third left frontal convolution (*Broca's Convolution*) is indicated (Fig. 89, B). Should there be facial spasm or paralysis, a lesion of the lower third of the ascending frontal and the contiguous part of the posterior end of the second frontal convolution is probably present (Fig. 89, R^1). Should there be paralysis of the arm—a brachial monoplegia—the middle portion of the ascending frontal and the contiguous part of the ascending parietal on the other side of the fissure of Rolando are probably affected (Fig. 89, R^1 and P^1). Should there be paralysis of the lower limb, the lesion probably involves the upper end of the ascending parietal and the superior parietal lobule lying behind it, as far as the margin of the longitudinal fissure (Fig. 89, P^1 and P^2).

Briefly, therefore, a cortical lesion may be distinguished from a central, as follows:—In the *cortical lesion* the paralysis, although it may occur immediately after the accident, often does not appear for some time. It is incomplete and localized, and probably affects only one limb or a single group of muscles. In the *central lesion*, on the other hand, the paralysis occurs immediately after the injury; it is more complete and extensive, and one side, at least, will probably be paralysed.

The *treatment* should be directed to the prevention of inflammation in the way already described. If there is a wound, with protrusion of the brain, the contused and protruded portions and any fragments pressing upon or penetrating the brain substance should be removed, the wound cleansed with antiseptics, the scalp replaced, and its union by the first intention sought. In the case of a gunshot wound the bullet should be removed if it can easily be got at, otherwise it should be left *in situ*. Where there is no wound, but signs of local irritation or of compression of the cortical motor area from blood-extravasation, the indications are to trephine. The guide to the

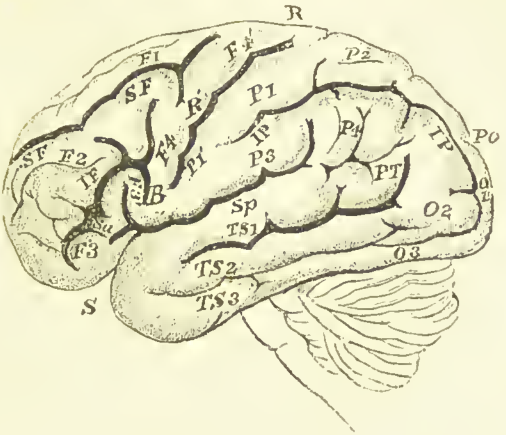


FIG. 89.—The cerebral convolutions: R, fissure of Rolando; F^4, ascending frontal convolution; P^1, ascending parietal convolution; F^1, F^2, F^3, superior, middle and inferior frontal convolutions; S F, superior frontal sulcus; I F, inferior frontal sulcus; S, fissure of Sylvius; S^a, anterior limb of fissure of Sylvius; S^p, posterior limb of fissure of Sylvius; P^2, superior parietal convolution; P^3, supra-marginal convolution; P^4, angular convolution: I P, inter-parietal fissure; T S^1, T S^2, T S^3, superior, middle and inferior temporo-sphenoidal convolutions; B, Broca's convolution; P^o, parieto-occipital fissure; O^1, O^2, O^3, superior, middle and inferior occipital convolutions.

(After Lucas-Championnière and Erichsen.)

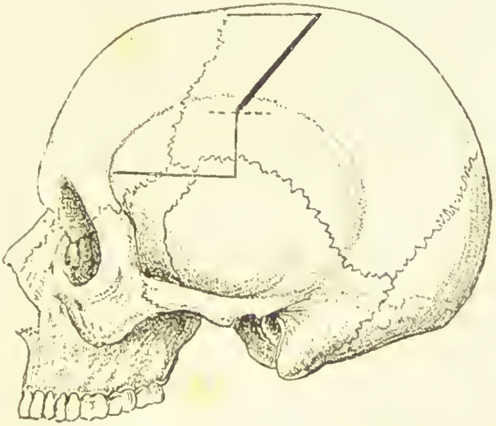


FIG. 90.—The situation of the line of Rolando.

spot for perforation is the line of the fissure of Rolando on the side opposite to that of the localized spasm or paralysis. This line may be found in various ways. M. Lucas-Championnière employs the following method (see Fig. 90):—He first finds the bregma, *i.e.*, the spot where the coronal joins the sagittal suture, by carrying a line directly over the vertex from one external auditory meatus to the other. The top of the Rolandic fissure is situated 55 millimetres behind the bregma. The bottom of the fissure corresponds to a spot 7 centimetres behind the external angular process and 3 centimetres above it. We have already seen that the cortical motor centres are grouped around the Rolandic fissure. If therefore there is general hemiplegia, the perforation should be made over the middle of the line; if paralysis of the arm and leg, over the upper part of the line; if paralysis of the arm only, in front of the middle third of the line; if aphasia, below and a little in front of the line on the left side of the head; if there is paralysis of the leg alone, behind the upper third of the line; if paralysis of the arm and face, in front of the lower third of the line; if paralysis of the arm and aphasia, or paralysis of the face and aphasia, below and in front of the line.

INTRACRANIAL INFLAMMATION, though at times it may remain localized either to the membranes (*meningitis*) or to the brain (*encephalitis*), more often, in whatever way it begins, spreads from the one to the other (*meningo-encephalitis*).

Cause.—Wounds of the scalp, contusions or fractures of the bone, and concussion, contusions, lacerations, and penetrating wounds of the brain.

Pathology.—It may be acute or chronic, septic and diffuse or circumscribed. *Acute inflammation* may begin in the dura mater, and remain confined to that membrane (*pachymeningitis*), or spread inwards to the other membranes and the brain; or it may begin in the brain, but then seldom spreads further outwards than the arachnoid (*leptomeningitis*). When it begins in the bone or in dura mater it is at first circumscribed; the inflammatory products, and, should suppuration occur, the pus, being confined between the bone and dura mater. Later, the inflammation may spread to the arachnoid, and thence to the pia mater and surface of the brain, diffusing itself widely through the subdural space and over the cerebral cortex. When it begins in the brain it is generally the result of a contusion or laceration of the cerebral substance, and may remain circumscribed, and eventually end in a cerebral abscess, or spread to the pia mater and then become diffuse. It seldom, however, involves the free surface of the arachnoid. The *post-mortem* appearances commonly observed are increased vascularity of the brain and its membranes, an exudation of greenish-yellow lymph, and distension of the ventricles with a serous blood-stained fluid; whilst the grey-matter is of a reddish hue, soft and diffluent, and the white more abundantly dotted over with puncta vasculosa than natural. In the *chronic form*, which is generally due to inflammation, caries or necrosis of the bone, or more rarely to a brain-injury, the dura mater becomes thickened and adherent to the bone, the arachnoid thickened, and the pia mater opaque and indurated, so that when removed its prolongations, which dip between the convolutions, can be pulled out without tearing.

The *symptoms* vary according as the inflammation is acute or chronic, diffuse or circumscribed; according as it begins in the dura mater or in the brain and pia mater; and according as it involves the vertex or base of the brain. The *general symptoms* in acute cases are in the early stages fever, pain in the head, generally on the same side as the wound if one is present, intolerance of light and sound, retching with probably a clean tongue, a quick, full pulse, flushed face, contracted pupils, violent beating of the carotids, restlessness, sleeplessness, and at times violent delirium. Later the symptoms pass into those of compression, the pupils becoming dilated and fixed, the pulse slow, and the breathing stertorous. Then follows paralysis, stupor, coma and death. Rigors will probably occur should pus form. In the *chronic form* of inflammation the symptoms are similar to those of the acute, but of less severity, and are later, as a rule, in making their appearance. Complete recovery may have apparently taken place, or there may have been headache or irritability of temper previous to the symptoms setting in. *Is there any way of localizing the inflammation?* 1. If ten to twenty days have elapsed since the injury; if the onset of the symptoms is sudden, though preceded perhaps by some headache; if there is a puffy swelling over the seat of injury, due to the separation of the pericranium from the bone by serous effusion; if the bone, should it be exposed, looks dry, white, and discoloured, or the wound unhealthy; and if the paralysis is localized,—the inflammation is probably between the bone and dura mater, and if a rigor has occurred, pus has probably formed. 2. If, on the other hand, there is no apparent injury of the scalp or bone; if the patient has had concussion; and if the symptoms set in a few hours after the injury, the inflammation is probably in the brain or pia mater, where it has arisen in consequence of increased vascularity following the concussion. Or if the symptoms come on about the fourth or fifth day after the injury, when it had apparently been recovered from, the inflammation will probably be also in the brain or pia mater, but in this case due to contusion or laceration of the brain. 3. If, again, the symptoms are delayed some weeks, if there is optic neuritis or symptoms of disturbance of one or more of the motor areas, the inflammation is probably localized to some portion of the brain, and if a rigor has occurred, a cerebral abscess has probably formed.

The *treatment* may be divided into the preventive and the curative. The former consists briefly in guarding against the occurrence of septic changes in the wound, if one is present, and in preventing congestion of the brain and its membranes by the means already indicated (see p. 335). The first signs of inflammation should be actively combated by a calomel purge, leeches to the temples and the ice-bag to the head; whilst pain should be subdued and sleep promoted by the cautious use of opium. The curative treatment consists in evacuating the products of the inflammation, should such, in spite of the preventive treatment, ensue. Thus, if there are signs of local suppuration between the bone and dura mater, the trephine should be applied over the seat of injury, or if one is not apparent, over the motor area, at the spot indicated by localized paralysis or spasm. If, on removing the bone, the dura mater is seen to bulge, and the pulsations of the brain cannot be felt, the dura mater should be perforated, and if pus is still undiscovered, but the signs of suppuration are well marked, a bistoury should be cautiously passed into the brain-substance. If there are signs of cerebral abscess, a trephine should be applied over the suspected spot, the dura mater incised, the brain carefully punctured, and if pus is discovered, a free incision made to let it out. If the suppuration appears to be general rather than local, no operative treatment should be undertaken.

HERNIA CEREBRI is a protrusion of brain-substance through a hole in the cranium and dura mater. *Cause.*—It appears to be due to a localized swelling of the brain, consequent upon inflammation, and may occur after any injury of the cranium where there is loss of bone and a wound or sloughing of the dura mater, with bruising or laceration of the brain. *Pathology.*—The protrusion consists of brain-substance infiltrated with inflammatory products and blood, and is the result of the inflammatory swelling finding a vent in the only possible way in which it can escape, viz., through the hole in the cranium. The effused blood is due to the rupture of the obstructed capillaries, consequent upon the protruding mass becoming constricted by the margins of the aperture through which it has protruded. At times, when the rupture of the capillaries is extensive, the tumour consists almost entirely of clotted blood. *Signs.*—The hernia appears as a reddish-brown, blood-stained, fungus-looking mass, overhanging the hole in the cranium, through which it has protruded, and often pulsating synchronously with the brain. Should the inflammation subside, the protrusion will gradually recede, and the patient recover; but should it continue, the hernia will increase in size, and as more and more of the brain is involved, the patient sinks into a comatose state and dies. At times the protrusion may become constricted at its base, and slough away and the parts cicatrize; or an abscess may form in its interior and in the contiguous part of the brain, and death result from cerebral compression. The *treatment* consists in attempting to allay the inflammation of the brain, which is the cause of the hernia, by the means already described in Intracranial Inflammation. Formerly, pressure on the protrusion, shaving it off, and applying caustics, were the means employed, but they were not attended with success, and are now discarded as unscientific. Pressure would rather tend to cause an abscess or promote inflammation by keeping up tension. The hernia itself should be left alone, except when the inflammation has become chronic, when well-regulated pressure may possibly promote the absorption of inflammatory products and the shrinking and recession of the mass.

TREPHINING THE SKULL is indicated:—1. In all cases of punctured fracture. 2. In depressed fracture with symptoms of compression, whether simple or compound. 3. In localized extravasations of blood between the bone and dura mater. 4. In intracranial suppuration when the pus is circumscribed and situated between the bone and dura mater, in the subdural or sub-arachnoid space, or in the substance of the brain. 5. In epilepsy, mania, and continued headache following on head-injury. 6. For the removal of a bullet lodged in an accessible situation in the brain. 7. In fracture of the inner table; and 8. For the removal of a cerebral tumour. In compound depressed fracture without symptoms, in which the fragment cannot be raised by the elevator, opinions differ as to the propriety of trephining. If the depression is considerable, I think it ought to be done, as should the patient escape the immediate danger of intracranial inflammation, he is liable to certain remote effects from the irritation of the depressed fragments, such as epilepsy, mania, &c. (see *Depressed Fracture*, p. 335). *The operation.*—If a wound of the scalp exists, it should be enlarged, otherwise a crucial incision may be made over the spot where the trephine is to be applied; or better, a large semi-circular flap of the scalp turned down in the way suggested by Mr. Horsley, so that when it is replaced after the operation the trephine-hole is completely covered. The pericranium having been turned back from the bone, the trephine, with the pin protruded one-eighth of an inch, should be applied, and steadily worked, clearing the teeth from time to time with a feather or the brush provided for the purpose in the trephine-case. A good groove having been formed in the bone, the pin should be withdrawn. When the diploë is reached, which may be known by the bone-dust being soft and red, greater caution must be used, and a probe introduced into the groove at intervals to ascertain whether perforation has taken place at any situation. When the crown of bone is loose it should be removed with the sequestrum forceps, and if it is intended to replace it, it should be kept warm in some weak antiseptic solution, and, at the end

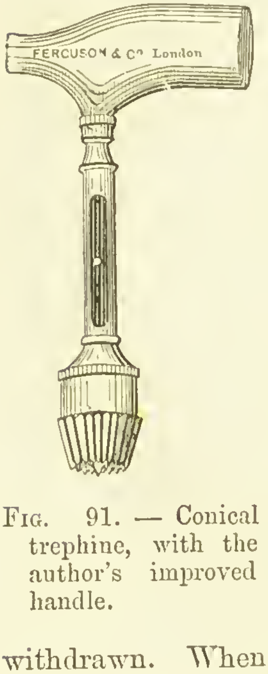


Fig. 91. — Conical trephine, with the author's improved handle.

of the operation, cut into small pieces and placed in the hole, and the flap laid down over it. If more room is necessary, the trephine hole may be enlarged by a Hey's saw, the surgical engine, &c. It need hardly be said that the strictest antiseptic precautions should be used throughout. Thus, the whole scalp should be shaved, and washed with soap and hot water, then with ether or ammonia to remove all grease, and afterwards with perchloride of mercury or other antiseptic. Healing by the first intention should be obtained if possible by accurately uniting the wound except at its lowest part which should be left open for drainage, and by applying a dry antiseptic dressing, and over it an ice-bag to prevent inflammation. The trephine should not be applied, as a rule, over a suture, an air or venous sinus, or over the middle meningeal artery, unless the operation is undertaken with a view to secure that vessel. The conical trephine, shown in Fig. 91, will be found a safer instrument than that in ordinary use, as with it it is impossible to injure the dura mater, and the handle also is more comfortable to work with. Before trephining for the removal of a cerebral tumour morphia should be given, as it causes contraction of the small blood-vessels, and so has a tendency to lessen the hæmorrhage.

INJURIES OF THE FACE.

CONTUSIONS of the face are very common. Amongst them may be mentioned "black-eye," which is attended with extravasation of blood in the loose cellular tissue of the eyelids. The swelling is often very great, the eye being completely closed, but it usually subsides in a few days. Suppuration occasionally occurs, a small incision then becoming necessary.

WOUNDS of the face, owing to the great vascularity of the parts, readily and rapidly heal. The edges of the wound should be approximated as accurately as possible, especially when near the eyelid, where there is danger of contraction, and united with horse-hair sutures. If quite superficial the wound may then be sealed with collodion; but if deep the surfaces should be supported by hare-lip pins or wire sutures, which however, to prevent scarring, should be removed at the end of twenty-four to thirty-six hours. Wounds attended by loss of substance may subsequently require a plastic operation.

FOREIGN BODIES IN THE NOSE.—Peas, beads, pebbles and the like are sometimes pushed up the nose by children, where they sooner or later give rise to irritation and a muco-purulent and fœtid discharge. Indeed the presence of such a discharge from one nostril in a child should always lead the Surgeon to make a careful search, if necessary under an anæsthetic, for a foreign body. If allowed to remain, foreign bodies may cause ulceration, or even bone-disease. They can generally be removed by forceps, curettes, or the nasal doucho, but before these are used the patient should close the opposite nostril and forcibly expire, since the body may often be expelled in this simple way. At times they may have to be pushed back into the pharynx. Milder means failing, Rouge's operation (see *Diseases of Nose*), may become necessary. It should not be forgotten that foreign bodies occasionally enter the nose from behind during vomiting.

FOREIGN BODIES IN THE EAR should be removed by syringing with tepid water, and no attempt made to extract them with instruments unless their nature is such that the warmth and moisture of the part may cause them to swell, as is the case with peas. Under these circumstances, some of the various aural curettes, snares, &c., devised for the purpose may be used, but with great gentleness and aided by artificial light, the child, if unruly, being placed under an anæsthetic. If a rounded body, as a bead, which is incapable of swelling, does not come away on syringing, it should be left alone for the time, as it will subsequently, by setting up slight suppuration, become loosened, and can then be removed by again using the syringe. The incautious use of instruments has been attended by perforation of the membrana tympani, and even followed by fatal intracranial inflammation. As a caution it may be mentioned that the handle of the malleus has ere now been mistaken for a foreign body and roughly torn out.

SALIVARY FISTULA occasionally results from a wound of Stenson's duct. It is known by a small fistulous opening on the cheek from which saliva dribbles, especially when food is being taken. *Treatment.*—Numerous operations have been proposed and practised for this somewhat troublesomo condition. The principlo underlying them all is, first to establish a free opening of the duct into the nouth, and then, if the external opening does not heal, o close it by a plastic operation.

FRACTURE OF THE NASAL BONES is always the result f severe direct violence. The fracture is commonly ransverse in direction, and is often comminuted and ccompanied by much displacement and at times by mphysema. Occasionally the fracture extends through he perpendicular plate of the ethmoid and thence to the ribriform plate. Hence it may be complicated by subequent inflammation of the brain and its membranes. *Treatment.*—The bones should be manipulated into position y the fingers externally and by a director passed up the ostril, or by the dressing forceps with one blade within nd one blade outside the nose. The fragments should hen be retained in position, which is often difficult, by ads of lint and strapping. The septum, where this has een deflected, should be straightened, so as to support he depressed bones, and kept in place by ivory plugs assed up the nostrils, or by other suitable retentive pparatus. Where the fracture has not been properly educed, much deformity may remain, and if the septum as also been deflected, considerable inconvenience may e felt in consequence of obstruction to respiration through ne or other nostril. In such cases, though a considerble period may have elapsed from the time of the ccident, much may be done by forcible straightening to emedy the deformity (see *Diseases of the Nose*). The ateral cartilages, if separated from the nasal bones, hould be carefully replaced, as if this precaution is eglected little can subsequently be done. Where, however, they are merely laterally deflected, the resulting eformity may be corrected by the use of a retentive pparatus.

FRACTURES OF THE UPPER JAW, or of the malar bone with depression of the zygomatic arch, are occasionally met with in severe smashes of the face. They are often mpossible to rectify, and considerable deformity frequently remains. Although much comminution may occur, necrosis, in consequence of the great vascularity of these parts, rarely results.

FRACTURE OF THE LOWER JAW is nearly always due to severe and direct violence. The fracture may extend through any portion of the bone, but commonly occurs a little to one or other side of the symphysis, the line of fracture being then usually vertical. In this situation, and indeed whenever the fracture involves the alveolar border, the mucous membrane of the gums is torn, rendering the fracture compound. It unites, however, nearly always like a simple fracture. There is not as a rule much displacement; but when, as occasionally happens, there is a fracture on both sides of the symphysis, the central portion is considerably depressed by the action of the genio-hyoid and digastric muscles. When the line of fracture extends through the angle or ascending ramus, the fragments are held in apposition by the masseter on the outer, and the internal pterygoid on the inner side. The fracture may occasionally occur through the coronoid process or the neck of the condyle. In the latter situation the displacement is peculiar, the condyle on the injured side being drawn forwards and inwards by the external pterygoid muscle of that side while the rest of the jaw is tilted over towards the injured side by the action of the opposite external pterygoid, which is thus left unopposed. This sign is of some importance in distinguishing such a fracture from a partial dislocation in which the jaw is drawn over to the side opposite the dislocation. *Signs.*—The common form of fracture may be readily distinguished by pain on mastication, dribbling of saliva, some irregularity in the line of the teeth, unnatural mobility of the fragments, crepitus, and a rent in the mucous membrane over the fracture. Fracture through the angle may be detected by crepitus and by the slight mobility of the fragments on firmly grasping the ascending ramus and body of the jaw. Fracture through the neck may be known by the peculiar displace-

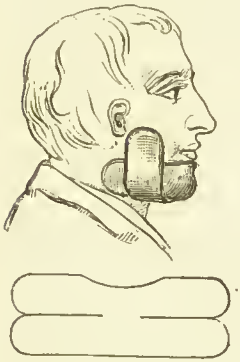


FIG. 92—Gutta percha splint for fractured jaw. (Bryant's Surgery.)

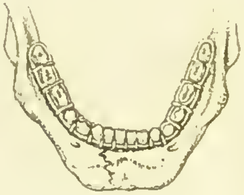
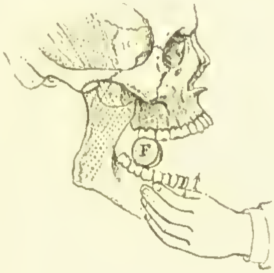


FIG. 93—Dental splint applied.

ment before alluded to, and, perhaps, by crepitus on manipulation. *Treatment.*—The parts should be placed in apposition and kept at perfect rest. This can usually be done by a gutta-percha splint moulded to the chin (Fig. 92), and secured by a four-tailed bandage (Fig. 95). All movements of the jaw must be avoided, the patient being fed on slops introduced either behind the last molar tooth or through any space left available by the loss of a tooth. In placing the parts in apposition some difficulty may be experienced in consequence of a displaced tooth having slipped between the fragments. If the parts cannot be kept in place by the simple splint above mentioned, they must be secured either by drilling the fragments and wiring them together, or by means of the dental splint shown in the accompanying drawing (Fig. 93). This splint consists of a wire frame fitted round the back and front of the teeth, and further secured by transverse wires between the teeth. One of the more elaborate, so-called interdental splints, may at times be found necessary. Union is usually accomplished in four or five weeks.



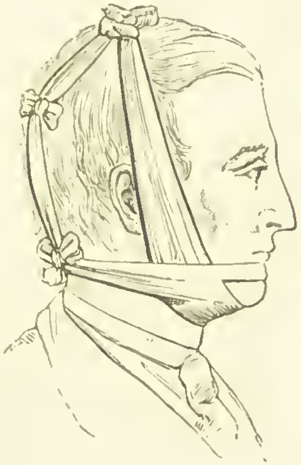


Fig. 94.—Mechanism of reduction of a dislocated jaw. F. Cork acting as fulcrum. The dotted lines represent the masseter and temporal muscles—the weight to be overcome by the hand or power.

Fig. 95.—The four-tailed bandage applied. (Bryant's Surgery.)

Dislocation of the lower jaw.—This accident may sometimes result from a fall or blow upon the chin with the mouth open, but more frequently occurs from spasmodic action of the external pterygoid muscles during yawning. When both condyles are displaced the dislocation is said to be complete; when only one is displaced, incomplete. *Nature of displacement.*—The condyle with the interarticular cartilage is drawn over the eminentia articularis into the zygomatic fossa, where it is firmly held by the contraction of the internal pterygoid, masseter, and temporal muscles. *Signs.*—The mouth is widely open and cannot be closed by any voluntary effort of the patient, and the saliva constantly dribbles away. In complete dislocation the symphysis remains in the middle line, and an unnatural hollow is felt behind each condyle. If the dislocation is partial the symphysis is carried over to the opposite side, and the hollow is felt only behind the dislocated condyle. *Treatment.*—The indications are to overcome the contracted muscles, and so allow the displaced condyle or condyles to be drawn by the temporal and deep fibres of the masseter, the retractors of the jaw, over the eminentia articularis into their sockets. A cork, or the thumbs, wrapped in a towel to avoid being bitten, should be placed between the last molar teeth of the upper and lower jaw on each side to act as a fulcrum whilst pressure is made in an upward direction on the symphysis by the Surgeon's hands on the principle of a lever of the first order (Fig. 94). Whilst the symphysis is pushed upwards the condyle is drawn downwards, the weight, represented by the contracted muscles, being gradually overcome. As soon as the condyle is thus clear of the eminentia articularis it is drawn back into its place with a snap by the fibres of the retractor muscles. At times in consequence it would appear of the coronoid process being wedged against the zygoma reduction cannot be effected in this way. Downward and backward pressure by the protected thumbs will then generally succeed. A four-tailed bandage (Fig. 95) should be worn for a fortnight to prevent re-dislocation, which is very liable to happen.

The term SUBLUXATION OF THE JAW is applied by some to a displacement of the condyle from the interarticular cartilage; by others to an unnatural slipping forwards of the interarticular cartilage on the eminentia articularis in consequence of rupture or elongation of the ligaments. The latter condition is most frequently met with in delicate young people. The condyle catches, and the mouth cannot be closed for a second or two, but it can generally be replaced by the patient's voluntary efforts with a distinct snap. *Treatment.*—If counter irritation and tonics do not succeed the joint may be opened and the cartilage secured in position by sutures.

INJURIES OF THE NECK, INCLUDING THE ENTRANCE OF FOREIGN BODIES INTO THE PHARYNX, ŒSOPHAGUS AND AIR-PASSAGES.

WOUNDS OF THE NECK.—Superficial wounds call for no special comment. Our attention here need only be given to wounds of the front of the neck, which are generally inflicted either with homicidal or suicidal intent. Such wounds are usually of the incised variety, more rarely punctured. They may be situated anywhere between the lower jaw and the top of the sternum, but are more common in the laryngeal region, especially through the thyro-hyoid membrane. Suicidal wounds are generally made obliquely from left to right and from above downwards, but may be transverse, and are commonly deeper on the left than on the right side. These facts are explained by the suicide generally using the right hand, and becoming less determined as he proceeds. There is usually but one gash, but there may be several, and again the gash may be superficial, or it may be deep, even extending to the spine. The structures involved will depend upon the situation, depth, and extent of the wound. Thus 1. When the wound is made above the hyoid bone the tongue may be severed, and the muscles that depress the jaw and elevate the hyoid bone and the lingual or facial arteries and the hypoglossal nerve divided. Such a wound will gape widely, and may open into the mouth, the food and saliva then escaping freely through it. 2. When the wound is through the thyro-hyoid membrane the pharynx will be opened, and the epiglottis, aryepiglottidean folds or arytenoid cartilages, the superior thyroid and lingual arteries, and the superior laryngeal nerve may be cut through. The wound gapes less than in the preceding situation, but allows of the escape of food and saliva. There is usually great difficulty in swallowing. 3. When the wound is through the cartilages, the vocal cords and one or other of the intrinsic laryngeal muscles may be divided, with consequent loss of voice; the cartilages themselves, moreover, may be variously displaced. There is as a rule but little hæmorrhage. 4. When the wound is made below the cricoid cartilage the depressor muscles of the larynx, the inferior or superior thyroid artery, and the thyroid and anterior jugular veins may be wounded, the trachea partly or entirely cut across, and even the œsophagus implicated.

Wherever the wound is situated the carotid arteries generally escape owing to the resistance of the cartilages of the larynx, the deep situation of the carotids, and the contraction of the sterno-mastoid muscles.

Dangers.—The immediate dangers are—1. *Hæmorrhage.* When the carotid artery or jugular vein is wounded death is generally, though not invariably, instantaneous; but even when no large vessel is implicated, death before help is obtained is frequent from hæmorrhage from some of the arteries above mentioned, the external jugular vein, &c. 2. *Obstruction to respiration* in consequence of (*a*) the blood entering the air-passages in larger quantities than the patient can cough up; (*b*), the lolling back of the tongue over the glottis; (*c*), the displacement of the cartilages; (*d*), the separation of the divided portions of the trachea. 3. *Entrance of air into the veins* is also an occasional danger. *The subsequent dangers* are—1. Œdematous laryngitis; 2. Bronchitis and broncho-pneumonia; 3. Inflammation and suppuration of the loose tissues of the neck even extending to the mediastinum or pleura, and, still later, 4. Obstruction of the air-passage with increasing dyspnœa or loss of voice from (*a*), constriction during cicatrization, or (*b*), formation of prominent granulations; and 5. Œsophageal or tracheal fistula.

Treatment.—The hæmorrhage must be arrested; the air-passages cleared if obstructed with blood, by suction if necessary; and artificial respiration resorted to if the patient has already ceased to breathe. If the tongue or epiglottis is divided it must be fixed by sutures, or if a portion of the epiglottis is loose it may be cut off. The wound, unless quite superficial, should not as a rule be approximated by suture or strapping, but by position, the patient being propped up and the head bent forwards. The cartilages of the larynx, if displaced, may be brought together by suture, as may also the trachea if divided. When the œsophagus is wounded the edges may be united by suturing the muscular coat, turning the mucous membrane inwards, and the patient fed by a tube passed through the mouth and beyond the wound, or at first entirely by the rectum. Tracheotomy may have to be performed if respiration is embarrassed by displacement of the laryngeal cartilages or by œdema of the glottis. When the air-passages are opened the precautions described under Tracheotomy must be taken to prevent lung-trouble. Suppuration must be watched for, and free exit given to pus as soon as detected.

CONTUSION of the larynx may be *caused* by blows or kicks of all kinds and manual compression, as in garotting. *Symptoms.*—Pain, especially on handling, localized swelling or ecchymosis, alteration or loss of voice, and slight hæmoptysis when the mucous membrane is lacerated. Unless there is much bleeding there is usually no dyspnœa, though this may subsequently be present should spasm or œdema of the glottis supervene. Severe compression of the larynx is said at times to have been instantly fatal from spasm of the glottis. The *treatment* should be directed towards allaying pain and preventing inflammation. Thus, a lead and opium lotion or an ice-bag may be applied over the larynx, and all attempts at speaking prohibited. Should signs of œdematous laryngitis appear, leeches, followed by hot fomentations, may be placed over the thyroid cartilage, whilst scarification of the glottis, and if this fails and suffocation threatens, intubation of the larynx or tracheotomy must be performed.

SUBCUTANEOUS RUPTURE OF THE TRACHEA is a rare accident, but may be caused by any violence applied to the neck. It is attended by emphysema and dyspnœa, and is usually rapidly fatal. An incision should be made in the middle line of the neck and an attempt made to draw the lower end of the trachea to the surface, and to pass in a tracheotomy tube.

FRACTURE AND DISLOCATION OF THE HYOID BONE.—*Fracture* may be produced by any violence applied to the neck, especially a severe grip. The line of fracture is usually about the junction of the greater cornu with the body, but may occur in any situation. The usual signs are pain, increased on handling, on turning the head, and on moving the tongue; dysphagia or inability to swallow; hoarseness or aphonia; a sense of suffocation on protruding the tongue; mobility of the fragments and crepitus; sometimes cough and dyspnœa; and hæmoptysis when there is laceration of the mucous membrane. *Treatment.*—The fragments should be replaced by the finger passed through the mouth, whilst the fingers of the other hand manipulate the bone externally, a gag and chloroform being usually necessary. The parts must then be kept perfectly quiet, and the patient fed on slops passed well to the back of the tongue.

What has been described as *dislocation* of the hyoid bone appears rather to be a condition of the parts due to relaxation of the ligaments attaching the thyroid cartilage to the hyoid bone.

FRACTURE OF THE CARTILAGES OF THE LARYNX.—The fracture may extend through either the thyroid or the cricoid cartilages, or through both. The thyroid alone is most usually fractured. *Cause.*—Direct violence applied to the part, such as a blow or fall, or compression with the hand, as in garotting. The usual *signs* are pain, increased on speaking, on swallowing, and on handling; dyspnœa; cough; expectoration of frothy blood, and later, when inflammation has come on, of offensive pus; emphysema when the mucous membrane is injured; great swelling and ecchymosis; and on examination, irregularity, undue prominence or flattening of the cartilages, crepitus, and preternatural mobility.

The danger to be apprehended is obstruction to the respiration in consequence of — 1, displacement of a portion of cartilage across the larynx; 2, spasm of the glottis from irritation of the fragments; 3, entrance of blood into the air-passages; 4, swelling from submucous extravasation of blood; 5, œdematous laryngitis; and, 6, perichondrial abscess and necrosis of the cartilage.

Treatment.—If the parts are fairly in apposition all that can be done is to steady them with a bandage and suitably-shaped pads of lint. But when there is serious displacement with perforation of the mucous membrane, as evidenced by severe dyspnœa and spitting of blood, tracheotomy should be *at once* performed, as otherwise the patient runs an imminent risk of sudden suffocation. An attempt may then be made with the hand manipulating the cartilage externally, and with the forefinger of the other hand in the pharynx, to rectify the displacement.

Injuries of the Pharynx and Œsophagus from within.

WOUNDS OF THE PHARYNX are not infrequently met with from falls with a pipe, stick, &c., in the mouth. They may be attended by severe hæmorrhage when the lateral walls of the pharynx are punctured, either immediately, or on removing the inflicting body, or later, from a portion of the stick or pipe being broken off and remaining as a foreign body in the wound where it has caused suppuration and ulceration of a vessel.

Treatment.—Any bleeding vessel seen should be secured, or failing this, pressure must be made with a stick wrapped round with lint, or solid perchloride of iron applied. As a last resource the common or external carotid must be tied. Should a foreign body be seen in the wound it should not be removed till preparations have been made (as by tying the carotid) to effectually arrest any hæmorrhage which might follow its extraction.

INJURIES OF THE ŒSOPHAGUS may be inflicted in attempts to remove a foreign body or to pass an œsophagus bougie; or its walls may be perforated by a fish-bone, &c., or may occasionally be ruptured during vomiting. Fatal hæmorrhage from the aorta, and perforation of the pericardium, pleura, and posterior mediastinum, followed by inflammation and death, have occasionally resulted from such injuries. *Treatment.*—Where a wound is suspected, the patient should at first be fed entirely by the rectum, and subsequently given only fluids in small quantities, so as to allow the wound time to heal.

BURNS AND SCALDS.—Burns of the pharynx occasionally occur from the inhalation of flame, as in a gas explosion or from the clothes taking fire; scalds are more common, especially among the children of the poor, from drinking boiling water or inhaling steam from the spout of a tea-kettle. In neither of these injuries is the œsophagus as a rule involved. In the case of burns the flame sometimes appears to be drawn through the larynx into the trachea. The boiling water is generally ejected from the mouth and nose, and only affects the entrance of the larynx. Both burns and scalds owe their gravity to the fact that they are frequently followed by œdematous laryngitis. The scalded and white appearance of the mucous membrane and the history of the case generally make the diagnosis plain. *Treatment.*—The patient should be carefully watched for signs of œdematous laryngitis. Should such supervene, the swollen mucous membrane at the entrance of the larynx may be scarified; but if this does not at once relieve, an O'Dwyer's tube should be placed in the glottis, or tracheotomy performed. In the slighter cases the application of a hot sponge to the larynx, the administration of small doses of antimony, tincture of aconite or calomel, or mercurial inunction may be tried.

CHARRING AND OTHER CHEMICAL LESIONS from drinking corrosive liquids, strong acids, or alkalies, are not uncommon. The effects vary according as they are taken intentionally or accidentally. In the former case, the larynx usually completely escapes, whilst the mouth, pharynx, œsophagus, and stomach, may be extensively injured. In the latter case, the fluid, on the discovery of the mistake, is expelled forcibly, and some of it thereby generally enters the larynx and nasal cavities, but little passes down the œsophagus. Here, as in burns and scalds, the chief danger to be apprehended is œdematous laryngitis. For an account of the effects that may follow swallowing corrosive fluids, the student is referred to a work on Forensic Medicine. It need only be remarked here that should the patient recover from the immediate dangers, he may subsequently come under the care of the Surgeon for stricture of the œsophagus, due to the cicatrization following the injury.

FOREIGN BODIES IN THE PHARYNX AND ŒSOPHAGUS.—Fish-bones, coins, false tooth-plates, and portions of food, are the bodies most commonly impacted in the pharynx and œsophagus. The situations at which they may become arrested, vary with the nature of the body. Fish-bones, pins, and the like, are easily caught in the loose folds about the tonsil and fauces, or may be impacted lengthwise across the pharynx. Larger bodies, as false tooth-plates, coins, &c., commonly become lodged about the cricoid cartilage. The *symptoms* and *treatment* vary according to the nature and size of the foreign body. A large portion of meat arrested over the entrance of the larynx will give rise to urgent symptoms of suffocation; and endeavours should be made to remove it instantly by the finger plunged into the throat. If this fails, laryngotomy should be done at once, and artificial respiration resorted to if the patient has already ceased to breathe. A fish-bone or pin may give rise to a pricking sensation with difficulty or pain on swallowing, and the patient will often be able to indicate the position where it has lodged. A search should be made for it in the mouth and throat, aided by the laryngoscopic mirror; but it must not be forgotten that the symptoms in consequence of the body having scratched the mucous membrane may persist even after it has been dissolved or swallowed. If in the tonsil or about the fauces, it may be removed with the dressing forceps, or it may be hooked out from the upper part of the pharynx by the finger nail. If a foreign body is beyond reach of the finger, an attempt must be made to extract it by forceps, or by some of the various forms of coin-catchers or the expanding horse-hair extractor (Fig. 96). If, after a thorough trial, with the patient under chloroform, these means fail, pharyngotomy must be performed, and the body removed through the opening in the neck. When situated lower down the œsophagus, and it cannot be extracted by gentle means, it had better be left alone in the hope that it may become loosened in a day or two by ulceration, and be expelled or pass down into the stomach. Should this not occur, an endeavour may again be made to extract it, or to push it onwards into the stomach. In these manipulations the greatest care must be taken, as if the body is sharp the œsophagus may easily be lacerated. When it has been pushed into the stomach the patient should be fed on oatmeal porridge, and made to swallow portions of hair, and the like, in the hope that the body, if angular, may become surrounded by this soft material and travel through the intestines without injuring them. Should it be too large to pass the pyloric valve, gastrotomy is the only resource.

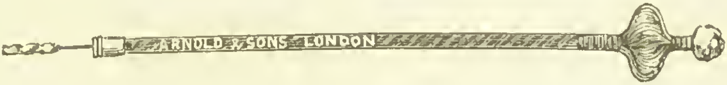


Fig. 96.—Expanding horse-hair extractor.

FOREIGN BODIES IN THE AIR PASSAGES.—A foreign body may become lodged in the larynx, the trachea, or in one of the bronchi.

Foreign bodies in the larynx.—A foreign body may be lodged above, below, or between the vocal cords, or in the ventricles. When a voluminous body, as a piece of meat, becomes impacted at the entrance of the larynx, it may block up the passage, causing instant suffocation. Smaller bodies, wherever situated, may also cause fatal dyspnœa by setting up reflex spasm of the muscles of the glottis; though in some cases a foreign body, such as a tooth-plate, may be so lodged between the cords as to prevent them closing. A foreign body in the ventricle may cause the same urgent symptoms. At other times the foreign body may give rise to severe, but not fatal, attacks of dyspnœa and spasmodic cough, though if not removed, inflammation and œdema will probably be set up and the patient ultimately succumb. *Treatment.*—Where the symptoms are urgent and the body cannot be removed by the finger, instant laryngotomy should be performed. But when less urgent, a deliberate attempt should be made to remove it by means of laryngeal forceps aided by the laryngoscope. Sometimes, where extraction would be otherwise impossible, this may be accomplished by cutting the body in two by the use of the laryngeal cutting-pliers. These means having failed, an external operation must be undertaken. Thus, when the foreign body is above the cords, it may be removed by sub-hyoid pharyngotomy; when between the cords or in the ventricle, by thyrotomy; when below the cords, by laryngo-tracheotomy or tracheotomy, the forceps in the last instance being passed up through the wound in the trachea.

Foreign bodies in the trachea and bronchi.—Small objects, such as coins, buttons, orange-pips, and fruit-stones, are liable to be drawn into the trachea during a sudden inspiration, while the patient is swallowing or is holding such in his mouth. The accident is most common in children. The foreign body may remain free, or become impacted either in the trachea or a bronchus (Fig. 97). It is usually said to most frequently enter the right bronchus, that being the larger, and the spur-like projection at the bifurcation of the trachea directing it that way, but the left is the more direct route, and the direction it takes would seem to depend in great part on the shape and size of the foreign body. The *symptoms* vary somewhat, according as the body is free or impacted. When it is free, and, as is usually the case, has fallen into one of the bronchi, there will be sudden and paroxysmal attacks of suffocative cough and dyspnœa, in consequence of the foreign body being driven upwards against the glottis, which then closes spasmodically. On listening over the trachea it may be heard to strike the cords, whilst a whistling sound may sometimes be detected as it passes up and down. During the intervals of the cough and dyspnœa, whilst the body is at rest in the bronchus, as is also the case when it is permanently impacted in it, there will be an absence of the breathing sounds over the whole or part of the lung on that side, according as the main bronchus or one of the secondary bronchi is obstructed; the resonance, however, will be normal or dull in places, according to the position and nature of the foreign body. If any air can pass the obstructing body, rhonchial or sibilant sounds may be heard, due in part to the bronchitis set up by it. Over the opposite lung puerile breathing may be detected. When the foreign body is of a rounded shape, it may act as a ball-valve, *i.e.*, it may allow air from the lung to be forced past it during expiration, but then fall back into a narrower part of the bronchus, and so prevent air entering during inspiration. In this way collapse of the lung is brought about. If the foreign body is not removed, or does not escape spontaneously, sudden death may occur during an attack of spasmodic dyspnœa; or it may set up bronchitis, pneumonia, or gangrene or abscess of the lung. At other times it induces more chronic changes, such as phthisis, or it may become encysted and no harm follow. In rare instances it may make its way out through the chest-walls by perforation or ulceration.

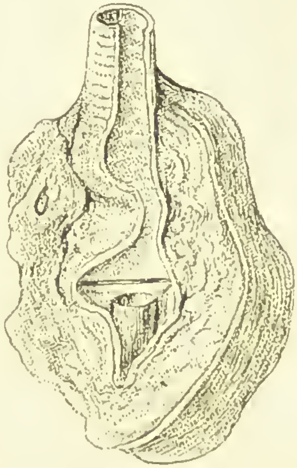


FIG. 97.—Foreign body in the right bronchus. The trachea is opened from the front. (St. Bartholomew's Hospital Museum.)

Treatment.—The patient should be inverted. Before doing this, however, everything should be in readiness for instant tracheotomy, in case the foreign body becomes lodged in the larynx and gives rise to spasm of the glottis. Children may be held up by the legs, but for adults some special contrivance may be necessary, as, for instance, Brunel's table. Inversion failing, tracheotomy should be performed, as the patient is in danger of suffocation at any instant. On opening the trachea, should the foreign body not be expelled at once, either through the wound, or, as sometimes happens, through the mouth, the patient may be again inverted, or search made for it through the wound with tracheal forceps, wire variously bent, &c. These means failing, the tracheotomy wound must be kept open to allow of future trials being made if the foreign body is not expelled during the interval.

PHARYNGOTOMY, or ŒSOPHAGOTOMY, is the operation of opening the lower part of the pharynx or upper part of the œsophagus for the purpose of removing a foreign body. As the œsophagus inclines to the left, the operation by choice is done on that side, unless the body be felt distinctly on the right side. Make an incision about four inches long, having its centre opposite the cricoid cartilage, parallel to the sterno-mastoid, over the interspace between the great vessels and the larynx. Divide the platysma and deep fascia; draw the sterno-mastoid outwards, and the sterno-hyoid and sterno-thyroid inwards; and divide the omo-hyoid if in the way. Gently draw the larynx and trachea across the middle line in order to separate them from the great vessels; and then open the pharynx or œsophagus, as the case may be, by cutting on the foreign body if felt, or on the point of a sound passed through the mouth and made to project in the wound. Avoid injuring the superior and inferior thyroid arteries and the recurrent laryngeal nerve.

INJURIES OF THE BACK.

SPRAINS of the spine are exceedingly common, and may be *caused* by any violent twist or bend of the back. The *pathology* of these injuries is hardly known. They are said to depend upon a partial tearing or rupture of the spinal ligaments, muscles, or fasciæ, but opportunities for verifying this statement seldom occur. Sprains of the back may be complicated by concussion of the spinal cord, extravasation of blood in the subcutaneous tissue, or contusion or rupture of the kidney. They may, moreover, be followed by inflammation of the intervertebral joints and fibrous tissue about the spine; the inflammation may then at times spread to the membranes and cord, or be the starting-point of vertebral caries. *Symptoms.*—The patient usually complains of having ricked his back, *i.e.*, of severe pain localized to one spot, commonly the lumbar region, and increased on movement and pressure. On examination no definite injury, beyond, perhaps, some obscure swelling about the tender spot, or more rarely, blood-extravasation, is discoverable. In the cervical region a sprain may sometimes simulate a dislocation, the pain causing the patient to hold the head in a fixed and one-sided position, thus rendering the transverse processes on one side of the neck more prominent than natural. In the lumbar region a severe sprain may sometimes simulate an injury of the spinal cord, inasmuch as the patient may complain of a weakness of the legs or inability to move them, or may even experience some difficulty in defæcating or passing urine. It will be found, however, that in these cases no true paralysis exists, but that the apparent loss of power is due to the pain which is induced on attempts at movement. The *treatment* consists in rest, and the application of hot fomentations to relieve pain, and later of stimulating liniments. In severe cases the patient should be kept in bed for a week or so, and subsequently shampooing, massage, and galvanism may have to be employed to overcome the pain and stiffness which often last for some time.

WOUNDS OF THE SPINAL MEMBRANES AND CORD may be inflicted by stabs in the back, falls on sharp bodies, &c. When the membranes alone are wounded, there may at first be no signs except perhaps an escape of cerebrospinal fluid; but later, should inflammation be set up, there will be the usual signs of spinal meningitis. A wound of the spinal nerves may be known by paralysis of the parts which they supply; a division of the cord, by complete paralysis of the parts below the seat of injury. The *treatment* consists in placing the patient at absolute rest, and in keeping the wound perfectly aseptic to prevent inflammation; but if the cord has been divided, permanent paralysis will necessarily ensue. Should inflammation occur, the appropriate remedies for meningitis must be administered. (See *Work on Medicine.*)

DISLOCATION AND FRACTURE.—Dislocation of the spine without fracture is exceedingly rare; indeed, except in the cervical region, it is said never to occur. Fracture unaccompanied by dislocation is also uncommon; but uncomplicated cases of fracture of the spinous processes and laminæ, and more rarely of the transverse and articular processes, are sometimes met with. In the majority of cases fracture and dislocation are combined. Thus, usually there is fracture of the body and articular processes of one or more of the vertebræ, with dislocation of the whole of the spine above the seat of injury from the spine below. This common form of injury is in the context spoken of as *fracture-dislocation.*

Fracture-dislocation. *Causes.*—It is either the result of *direct violence* applied to the spine, or *indirect violence*, as a fall upon the head. 1. When the result of *direct* violence, which can only be applied to the posterior part of the spine, one or more of the spinous processes may be detached without implicating the vertebral canal. When the violence is very great, as in a fall from a height on the back across a beam or rail, or a severe blow, as from a crane, the spine is bent violently backwards, tearing asunder the structures forming the anterior segment of the column, and crushing those forming the posterior. Hence the vertebral bodies are generally uninjured, but wrenched apart, the intervertebral cartilages are ruptured, the anterior common ligament is torn, and the arches of the vertebræ and the articular and spinous processes are crushed. The vertebræ above the injury are dislocated forwards, as the articular processes being fractured and the intervertebral cartilages torn, nothing remains to keep them in position. 2. In fracture from *indirect* violence (Fig. 98), such as may be received in a fall from a height upon the head, or catching the head whilst passing under an arch, or from a weight falling upon the shoulders, the spine is bent violently forwards, crushing the anterior part of the column and tearing the posterior asunder. Here one or more of the bodies and intervertebral cartilages are crushed between the vertebræ above and the vertebræ below, one of the fragments of the fractured body being frequently driven backwards into the vertebral canal, whilst the arches and the spinous and articular processes are wrenched asunder. Fracture of the sternum is occasionally combined with this injury, in consequence of the chin, it is said, coming into violent contact with the sternum as the spine is doubled forwards.

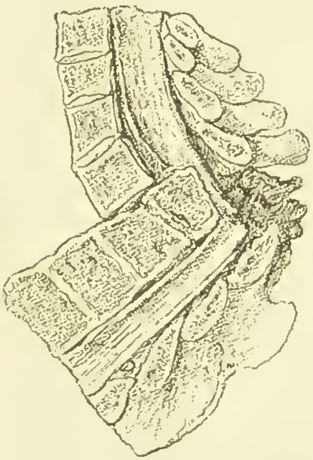


Fig. 98. — Fracture - dislocation of the spine. (St. Bartholomew's Hospital Museum.)

Condition of the spinal cord.—The importance of fracture-dislocation of the spine lies not so much in the fact that the vertebræ are fractured, as that the cord is generally injured. When the vertebræ are not displaced, the cord may at times altogether escape. More commonly, however, it is compressed, or, perhaps, completely divided, or again so bruised that it rapidly undergoes inflammatory softening. When the injury is situated below the second lumbar vertebra, the cord necessarily escapes as it terminates at that spot, but the nerves of the cauda equina may then be injured.

Signs and symptoms.—The local signs are often but little marked. There may be pain at the seat of injury, or some inequality in the spinous processes; but as often as not these are absent. The general signs depend upon the condition of the cord, and none will be present when it has escaped injury. But when it is compressed or crushed there will be paralysis of the parts below, more or less complete according to the extent of the lesion. Taking as an example a case of fracture in the lower cervical or upper dorsal region—the most common situation—with severe compression or crushing of the cord, there will be paralysis of both motion and sensation of the whole of the parts below the seat of injury (*paraplegia*), and perhaps a zone of hyperæsthesia immediately above the injured part. The intercostal muscles being paralysed respiration can only be carried on by the diaphragm, this muscle receiving its nerve-supply through the phrenics which are given off above the seat of injury. Hence, whilst the chest is motionless, the abdomen rises and falls during respiration. The bladder and rectum and their respective sphincters share in the paralysis, so that there is at first retention of urine and fæces, followed by passive overflow of urine as the bladder becomes distended and will hold no more, and by involuntary passage of fæces. Priapism, or involuntary erection of the penis, is frequently present, or is induced by the use of the catheter. The temperature varies; sometimes it may be lower than normal, but often it is considerably raised, even reaching as high as 107° shortly before death. Consciousness, unless any head-injury has been received at the same time, is not affected. The reflexes are usually at first in abeyance; but return in the lower limbs if the patient does not succumb to the shock of the injury. Death occurs, as a rule, from twenty-four hours to a few days from bronchial trouble; but the patient, if the fracture is in the upper dorsal region, may linger from two to three weeks. The secondary troubles which are then generally met with are *bedsores* and *chronic cystitis*. 1. The bedsores occur in situations subjected to pressure, and depend in great part on the congestion and lowered vitality of the tissues induced by the impairment of the nerve influence; but they are also to some extent due to the soddening of the part with the urine and fæces from which it is very difficult to keep the patient free. 2. The chronic cystitis is probably also due in part to impaired nerve-influence, and in part to slight injury in the passage of a catheter, or to the introduction by the catheter of a micro-organism—the micrococcus ureæ. The urine, which is at first acid, becomes ammoniacal from the conversion of the urea into carbonate of ammonia, and thick from the deposit of phosphates and the presence of ropy mucus. The inflammation may then extend up the ureter to the kidney, where suppuration of the pelvis and substance of the kidney (*pyelo-nephritis*) may be set up.

Such may be taken as a typical example of fracture of the spine as commonly met with in surgical practice. But the nature and gravity of the symptoms will depend upon the situation of the fracture, and the amount of injury to the cord. Thus in some cases of fracture there may be no paralysis: in others the paralysis may be incomplete, *i.e.*, confined to loss of motion only, or to paralysis of one limb or one group of muscles, or to impairment of sensation over some limited area. Such cases, however, are much less common than that above described.

Causes of death.—1. When the fracture is above the fourth cervical vertebra, death is instantaneous in consequence of the severance of the phrenic nerves from the respiratory centre in the medulla. 2. In the lower cervical or upper dorsal region, death is due either to (*a*), hæmorrhage in the cord gradually extending to the origin of the phrenic nerves, or (*b*), a low form of bronchitis induced partly by hypostatic congestion, partly by defective nerve-influence, and partly by inability to clear the lungs effectually by coughing. 3. Later, death is commonly due to exhaustion produced by (*a*), the sloughing of the bedsores, or (*b*), the pyelo-nephritis, induced in part by the extension of cystitis up the ureters to the kidney, and in part by the defective nerve-influence on the kidney structure.

The *prognosis* will depend in great measure on the situation of the fracture. Thus, when it is *in the cervical region*, if death is not instantaneous, the patient may survive from twelve hours to two or three days; usually, however, death occurs in about twenty-four hours. *In the upper dorsal region* the patient may linger for two or three weeks. *In the lower dorsal region*, if he survive the period at which the inflammatory troubles commonly occur, he may recover, remaining, however, paraplegic. *In the lumbar region* he may recover, with perhaps only partial paralysis of one or other of the lower limbs or of a certain group of muscles, or even without any paralysis whatever. But even where the injury to the cord has been so high as to cause paralysis of the whole body below the neck, patients have been known in rare instances to live for several months or even years.

Treatment.—1. In cases where there is no paralysis, thus showing that the cord is not affected, the indication is to keep the fractured spine at perfect rest, for the purpose not only of obtaining union of the fracture, but also of preventing by any movement displacement of the fragments and injury of the cord. 2. In the more common cases, where there is paralysis, showing that the cord is injured, the indications are to remove any fragments that may be compressing the cord, and subsequently to keep the parts at rest till union has occurred. 3. Where, however, as is too frequently the case, the removal of the fragments is not practicable, or the cord itself has been crushed, all that can be done is to endeavour to guard against the formation of bedsores, and the occurrence of chronic cystitis and its attendant evils. Thus the patient should be placed upon a water bed, and his posture gently changed from time to time so that pressure may not be continuously made on one part, while he must be kept scrupulously clean and dry, and free from urine and fæces. The bowels should be cleared, if necessary by enemata, or excessive diarrhœa controlled by morphia suppositories or starch and opium injections. Should bedsores threaten, the skin should be hardened by sponging with rectified spirit, and dusted with oxide of zinc and starch powder. If formed, they should be dressed with mild antiseptics, iodoform, balsam of Peru, &c., and all pressure removed from the surrounding skin by the use of water cushions. To prevent cystitis from occurring a soft rubber catheter, thoroughly cleansed in carbolic acid and dipped in carbolic oil, should be passed twice daily. Should the urine become alkaline the bladder must be washed out with some antiseptic solution. 4. In cases where, from the marked inequality of the spinous processes there is a probability of fragments pressing upon the cord, a cautious attempt to extend the spine and reduce the displaced vertebræ may be made, and a plaster-of-Paris case applied during the extension. In rare instances it may be justifiable to trephine the spine for the purpose of removing a fragment or extravasated blood; but space will not permit of the discussion of this interesting question.

CONCUSSION OF THE SPINAL CORD.—This term has been applied to various injuries of the cord received in railway and other accidents. It ought, however, to be restricted to those cases in which the cord is merely concussed or shaken; and the other injuries, such as hæmorrhage into its substance or into the arachnoid, contusions, and lacerations, all of which have been included under the term concussion, described as spinal hæmorrhage, laceration of the spinal cord, &c. Concussion in this sense is one of the rarest of injuries, and need not detain us in a work of this character. For an account of the other lesions, and the very various, apparently anomalous, and, as yet, far from understood symptoms which may attend them, and which are generally classed together under the term of the "railway spine," a larger work must be consulted.

INJURIES OF THE CHEST.

Injuries of the Chest-walls.

CONTUSIONS may be produced by any sort of violence applied to the chest, and may be attended with laceration or rupture of the muscles, or with extravasation of blood into the tissues, which, again, may be followed by suppuration and abscess. They owe their chief importance, however, to the fact that they may be complicated by serious injury to the contained viscera, such as contusion or laceration of the pleura, lung, heart, or pericardium, or rupture of a large vessel in the mediastina.

FRACTURE OF THE RIBS is a very common accident. *Cause.*—Generally external violence, rarely muscular action. 1. *External violence* may be—(*a*) *Direct*, such as a kick of a horse, a fall upon the edge of a table, &c. The fracture then occurs at the seat of injury, the fragments being driven inwards, occasionally injuring the thoracic, or more rarely, the abdominal viscera; or (*b*) *Indirect*, as a severe compression of the chest in a crowd. The fracture then generally occurs about the angle of the ribs, their weakest part, and several bones are usually broken. 2. *Muscular action.*—The ribs are sometimes broken in this way during violent coughing, or from straining during parturition.

Complication.—Fractures of the ribs may be complicated by an external wound; a wound of the pleura and lung, or pericardium and heart; laceration of a blood-vessel, as an intercostal artery; penetration of the diaphragm; and more rarely by perforation of the peritoneum, and wound of the liver or spleen. Hence they may be followed by emphysema, pneumothorax, hæmothorax, hæmoptysis, hæmopericardium, and later by pleurisy, pneumonia, pericarditis, or peritonitis.

State of the parts.—Fracture of the ribs is more common in the old than in the young, on account of the loss of elasticity as age advances. Like fractures of other bones, they may be simple, compound, or comminuted. The middle ribs are those usually affected; the first and second rib being protected by the clavicle, and the eleventh and twelfth being moveable, are not often broken. Fracture of the upper ribs is more serious than fracture of the lower, as the lung is more liable to be wounded.

Signs.—Severe stabbing pain is felt over the seat of fracture, and is increased on taking a deep breath, or on coughing. On drawing the finger along the rib, some irregularity may be detected. Crepitus is usually felt on placing the hand flat over the fracture while the patient breathes deeply, or it may be heard on listening with the stethoscope. Emphysema, *i.e.*, a crackling sensation, something like rubbing tho hair between the fingers, may at times be felt on touching the part. It is nearly always due to a wound of the lung, the air being drawn into the pleura through the visceral layer during inspiration, and forced through the wound in the parietal layer into the subcutaneous tissue during expiration.

Treatment.—In an ordinary case the injured side should be strapped with adhesive plaster, so as to control the respiration on that side and thus place the fractured rib as much as possible at rest. A broad bandage in addition applied round the chest often gives relief. When several ribs are broken a shield of gutta-percha may be moulded to the chest-walls and strapped on. Union occurs by ensheathing callus in three or four weeks.

FRACTURE OF THE STERNUM is rare. It may be accompanied by fracture of the ribs or costal cartilages, separation of the ribs from their cartilages, and sometimes by fracture of the spine. *Causes.*—Direct violence; indirect violence in consequence of a forcible bend of the body, either backwards or forwards; very rarely, muscular action, as during parturition.

State of the parts.—The line of fracture generally runs through the gladiolus, and may be transverse, oblique, or longitudinal, the lower fragment usually projecting in front of the upper; but at times the gladiolus is separated from the manubrium, a condition sometimes spoken of as *dislocation of the sternum.* The chief *signs* are pain, increased on deep inspiration and coughing, irregularity and crepitus at the seat of fracture, and emphysema if the lung is wounded. The fracture may be complicated by injury of any of the thoracic viscera, or by hæmorrhage or suppuration in the anterior mediastinum. *Treatment.*—Rest on the back, and the application of a bandage, if it can be borne, round the chest.

WOUNDS OF THE CHEST-WALLS may be divided into the penetrating and non-penetrating. The *non-penetrating* are of no serious consequence, and may be treated like wounds in other situations. The *penetrating* are those that pass through the parietes into the pleura, pericardium, or mediastinum, and may be complicated by a wound of the lung, the heart, a large blood-vessel, an intercostal artery, or the internal mammary artery. When the wound is small, and there are no signs of injury to the thoracic viscera, it is not always possible to determine whether it has penetrated the chest-wall; although the direction and situation of the wound, and an account of the way in which it was inflicted, may point to its having done so. Under these circumstances, the wound should on no account be probed, but the patient treated as if the wound had penetrated, and watched for signs of inflammatory complications. The symptoms and treatment will depend upon the viscus wounded. (See *Wounds of Thoracic Viscera.*)

Injuries of the contents of the Chest.

These may be divided into injuries of the—1, pleura and lung; 2, pericardium and heart; and 3, large blood-vessels.

1. INJURIES OF THE PLEURA AND LUNG.—*Contusion of the lung* without an external wound may be produced by a severe crush of or blow upon the chest. The visceral layer of the pleura may or may not be lacerated. It is attended with paroxysmal dyspnœa, cough, localized dulness, and crepitation, followed in a few days by expectoration of rusty sputa. If the visceral layer of the pleura is lacerated, blood and air may escape into the pleural cavity, and there will then be, in addition to the above, signs of hæmo-pneumothorax. The patient usually recovers in a few days, but pneumonia, pleurisy, or abscess or gangrene of the lung occasionally ensue.

Wounds of the pleura and lung may be produced by the fragments of a broken rib, or by a stab or gunshot. When attended with a penetrating wound of the chest, they are very serious. The pleura alone may be wounded, but more often the lung is injured at the same time. *Signs.*—No single symptom is sufficient to make it certain that the lung has been wounded; but where several of the following are present, the diagnosis becomes fairly certain. Thus, there may be severe shock, abdominal breathing, and cough with expectoration of frothy blood-stained mucus, or even of pure blood. If there is an external wound, there will be escape of air intimately mixed with blood, and accompanied by a peculiar hissing noise (*hæmatopnœa*); or if there is no external wound, emphysema in the region of the fractured rib. When the pleura alone is injured, a very rare accident, the signs are similar; but no blood is coughed up, and though air may escape from the external wound if there be one, it is not churned into a fine froth with the blood, as it does not come from the lung, but is simply drawn in and out of the pleura through the wound in the parietes during inspiration and expiration. *Complications.*—Hæmothorax, pneumothorax, emphysema, hæmorrhage, and later pleurisy and pneumonia (see *Complications of Injuries of Chest*). *Treatment.*—Absolute rest, ice to suck, opium to subdue pain, closure of the wound if small, or insertion of drain-tube if large, and antiseptic dressings, with such treatment as is appropriate for the complications that may be present (see below). If the pleura alone is injured, the external wound should be closed, unless any complication exists, and dressed antiseptically.

2. INJURIES OF THE HEART AND PERICARDIUM.—*Contusions, wounds, and rupture of the pericardium* may at times be produced by a severe crush of the chest-walls; but are more often due to the penetration of a fragment of a broken rib, or to a stab or gunshot. In the last two instances the heart is generally also involved. *Signs.*—Severe shock, hæmorrhage, the position and direction of the wound, and subsequently symptoms of pericarditis. The prognosis is always very serious, death occurring either from the effused blood impeding the heart's action, or from pericarditis. The *treatment* consists in absolute rest, the local application of cold, and if inflammation threatens, of leeches. Should the heart's action become seriously impeded by effused blood, serum, or pus, aspiration or free incision and drainage may be required. When there is an external wound, it should be dressed antiseptically.

Wounds of the heart, especially when they penetrate one of its cavities and involve an auricle, are generally instantaneously fatal from shock or hæmorrhage. Remarkable exceptions however occur, and patients have been known to linger for a few hours or a few days, or even to recover. *Signs.*—When not at once fatal, a wound of the heart is attended with great collapse, syncope, a fluttering pulse, and dyspnœa, and later with symptoms of pericarditis. The *treatment* is the same as that for a wound of the pericardium.

Rupture of the heart, though rare, occasionally occurs as the result of great external violence to the chest-walls, or of some sudden exertion on the part of a patient suffering from disease of the heart's substance. Death is as a rule almost instantaneous.

3. WOUNDS OF THE LARGE BLOOD-VESSELS, as the aorta or vena cava, are almost invariably and immediately fatal, and require no further comment here.

Complications of Injuries of the Chest.

The chief complications attending injuries of the chest are:—1, external hæmorrhage; 2, hæmothorax; 3, emphysema; 4, pneumothorax; 5, prolapse and hernia of the lung; 6, pleurisy; 7, pneumonia; 8, hæmopericardium; 9, pericarditis; 10, mediastinal abscess.

1. EXTERNAL HÆMORRHAGE in penetrating wounds of the chest-walls may come from:—(1), an intercostal artery; (2), the internal mammary artery; (3), a wound of the lung; or (4), a wound of the heart or one of the large vessels. Hæmorrhage from an intercostal or the internal mammary artery, though it may generally be known by the blood escaping in jets, is sometimes difficult to distinguish from hæmorrhage from the lung. In such a case it is said that if a card be introduced into the wound, the blood, if it comes from an artery in the chest-wall, will flow over the outer surface of the card, but if it comes from the lung will well up around the card. Hæmorrhage from the heart or one of the large vessels is as a rule immediately fatal. *Treatment.*—1. An intercostal artery should, if possible, be tied; otherwise a pressure forceps may be left on, or the artery with the periosteum may be separated from the lower half of the rib and then tied, or a portion of the rib may be excised. 2. The internal mammary in the four upper spaces can be easily tied; in the lower spaces a portion of the costal cartilage must be first cut away. 3. When the bleeding is from the lung the patient must be placed at perfect rest on the injured side, and an ice-bag applied. Internally, lead and opium, gallic acid, or ergot, may be given. Some recommend the closing of the external wound and the application of a bandage to the chest, so that the blood may collect in the pleura, press on the lung, and thus stop the bleeding.

2. HÆMOTHORAX, or hæmorrhage into the pleura, may occur either with or without an external wound. It is, perhaps, most often due to a fragment of a broken rib penetrating the lung or wounding an intercostal artery. *The signs* are those of internal hæmorrhage with rapidly extending dulness to percussion, absence of breathing sounds, bulging of the intercostal spaces, and increasing dyspnœa. It may be distinguished from pleurisy and pneumonia by coming on immediately after the injury and by the absence of fever. *Treatment.*—Similar to that for hæmorrhage from a wounded lung. Should the breathing become dangerously embarrassed the blood must be drawn off with the aspirator. Should suppuration occur the chest must be opened and freely drained.

3. PNEUMOTHORAX, or air in the pleura, is generally

the result of a wound of the lung by a fragment of a broken rib. It may be known by increased resonance to percussion, amphoric breathing, metallic tinkling, bulging of the intercostal spaces, and increasing dyspnœa. When combined with hæmothorax or with pleuritic effusion, the lower part of the chest will be dull to percussion, and a splashing sound on shaking the patient (*succussion*) may be heard on auscultation. The air is usually absorbed, but should the breathing become seriously affected it may be removed with the aspirator.

4. EMPHYSEMA, or surgical emphysema as it is sometimes called to distinguish it from the medical affection of the same name in which the air-cells of the lung are dilated, is air in the connective-tissue spaces. It is generally due to a wound of the lung combined with a laceration of the parietal and visceral layers of the pleura, and is a very frequent complication of fractured ribs. The air either escapes into the pleura at each inspiration, and thence during expiration is forced through the parietal layer into the subcutaneous connective tissue, or it passes, if there are adhesions between the two layers of the pleura, directly from the lung into the subcutaneous tissue. More rarely it is due to a rupture of the lung without injury of the pleura, the air then escaping at the root of the lung into the posterior mediastinum, and thence into the connective tissue of the neck and arms. More rarely still it may occur without a wound of the lung, or even without a wound of the pleura. *Signs.*—The emphysema, though usually limited to the seat of injury, may extend somewhat widely around it, and in rare instances has spread over the whole body. It gives rise to an ill-defined flattened swelling unattended with signs of inflammation and unaltered on inspiration and expiration. On pressing on the swelling a peculiar crackling sensation is experienced, like that of rubbing the hair between the fingers. *Treatment.*—A pad and bandage is all that is usually necessary, but should the air instead of becoming absorbed extend so widely as to interfere with respiration, a puncture or two must be made to let it escape.

PROLAPSE AND HERNIA OF THE LUNG.—*Prolapse* of the lung occasionally occurs through a wound in the chest-wall. It should be returned by gentle pressure, the wound being slightly enlarged if necessary. If the prolapsed portion has become adherent and congested it may be removed by the knife or ligature, taking care not to break down the adhesions of the visceral layer of the pleura to the chest-wall and so open the pleural cavity. *Hernia of the lung* is sometimes met with after a penetrating wound of the chest has cicatrized, or even when there has been no wound of the skin. It forms a soft, crepitating, resonant swelling, which can be made smaller by pressure, and generally becomes more prominent on forced expiration or coughing. On listening over it a harsh vesicular murmur is heard. *The treatment* consists in protecting it with a properly-shaped pad or leather shield moulded to the part.

For an account of such complications as *Pleurisy*, *Pneumonia*, *Hœmopericardium*, *Pericarditis*, and *Mediastinal Abscess*, a larger work, or one on Medicine, must be consulted.

OPERATIONS ON THE CHEST.—*Tapping the pleura* should be done when the effusion is serous without admitting air, either with the aspirator or with the syphon-trochar and cannula. The spot usually selected is the sixth intercostal space in the mid-axillary line. A small incision is first made through the skin, which should be drawn down on the rib so that the wound may be valvular. The needle of the aspirator or the trochar and cannula is then thrust into the pleural cavity. The fluid should be allowed to escape slowly, and its flow stopped for a minute or so if coughing occurs. The instrument must be withdrawn should any blood become mixed with the fluid. The wound should be dusted with iodoform and closed with a pad of antiseptic gauze.

Incision and drainage of the pleura may be required for empyema, the removal of putrid clots, &c. The incision may be made in the sixth intercostal space in the mid-axillary line, or in the ninth or tenth space in a line with the angle of the scapula. Chloroform should be given, and a careful dissection made between the ribs down to the pleura, or a director may be thrust through the muscles into the pleural cavity and the wound sufficiently enlarged by passing a dressing forceps along the director and forcibly opening the blades. A drainage-tube should then be inserted. If the space between the ribs is insufficient a piece of a rib may be excised. The wound should be treated antiseptically, and if pus again collects a counter-opening may be made.

Thoracoplasty or Estlander's operation consists in removing a portion of several of the ribs for the purpose of allowing the chest-walls to fall in, in cases of empyema where after the pleura has been drained the lung in consequence of adhesions does not expand. An incision three or four inches in length may be made obliquely downwards and inwards over the side of the chest just in front of the latissimus dorsi across the ribs, the portions of which it is intended to excise. The edges of the wound being retracted to expose the ribs an incision is next made through the periosteum along the course of each rib for the required distance, the periosteum separated with a raspatory from both the outer and inner surface, and the rib then cut through with the saw or bone-forceps at each end of the incision, the soft parts being protected by a spatula passed beneath the rib.

Tapping the pericardium.—The puncture should be made with the aspirator in the fourth or fifth intercostal space on the left side about two inches from the sternum or immediately to the left of the sternum. Care should be taken not to injure the internal mammary or an intercostal artery, and not to thrust the needle too deep lest the heart be punctured.

Incision and drainage of the pericardium may be required for pus in its cavity. An incision about two inches long should be made along the upper border of the fifth or sixth rib, beginning one inch from the sternum. When the pericardium is reached it should be freely opened, a drainage-tube inserted, and antiseptic dressings applied.

Pneumotomy, or incising the lung for the purpose of opening an abscess or hydatid cyst, or of draining a phthisical or bronchiectatic cavity, has in a few instances been done. An incision is made down to the pleura, a trochar and cannula then thrust into the cavity in the lung, and the wound made by the cannula cautiously enlarged by dressing forceps.

INJURIES OF THE ABDOMEN.

CONTUSIONS of the abdominal wall, especially when due to a sharp or sudden blow or a severe crush, should always be regarded as serious, as they may be complicated by grave internal injuries. Thus, the peritoneum may be lacerated, one of the viscera ruptured, or a large blood-vessel injured and blood extravasated into the peritoneum or subperitoneal tissue; whilst among the minor complications may be mentioned rupture of the rectus or other muscle of the abdominal wall accompanied by blood-effusion (*hæmatoma*) and possibly followed by suppuration and abscess. Even where no injury to the viscera has been sustained, a contusion of the abdomen is nearly always attended with shock which may be severe, and in some instances has been fatal, probably from an injury to the solar plexus. The *signs* of a simple contusion are pain, ecchymosis, tenderness and swelling, with a varying amount of shock. A ruptured rectus will be indicated by pain on putting the muscle into action, and the presence of a gap, and later of a swelling from the effusion of blood. A blood-tumour will be known by its sudden occurrence, and absence of signs of inflammation. *Treatment.*—The patient should be treated as if he had sustained a grave injury, since it is not possible at first to say if such is not the case. Thus, he should be placed at absolute rest in bed, hot fomentations applied to the abdomen and hot bottles to the extremities, and opium given internally; whilst for precaution's sake for the first twelve or twenty-four hours nothing should be given by the mouth or only small quantities of iced milk. Where there is rupture of the rectus the parts should be approximated as much as possible by position. If a blood-tumour forms cold should be applied, but it should on no account be opened, as the blood will nearly always in time be absorbed.

LACERATION OF THE PERITONEUM may occur from a blow or crush of the abdomen without injury of the viscera, and may be complicated when a large vessel has been ruptured by extravasation of blood into the peritoneal cavity or sub-peritoneal tissue. There are no special *signs* of this injury; but restlessness, a sensation of sinking, yawning, an anxious countenance, coldness and blanching of the surface when complicated by hæmorrhage, with an absence of vomiting and often of pain, are said to indicate it. Peritonitis nearly always quickly supervenes. *Treatment.*—Like that of peritonitis.

SUPPURATION AND ABSCESS may follow on any injury of the abdominal walls, or extravasation of urine; or may be due to the breaking down of a blood-tumour or syphilitic gumma, or to disease of the bones forming the walls of the abdomen or pelvis. The suppuration may be acute or chronic, superficial or deep. When deep it is very apt to be diffuse, and extend along the muscular planes or between the peritoneum and transversalis. When superficial, except as the result of extravasation of urine, it is generally circumscribed and often confined to the sheath of the rectus. *Signs.*—The acute form is attended with the general and local symptoms of inflammation, followed by those of suppuration, and subsequently, by the signs of an abscess. In the chronic form there will probably be no constitutional signs; but a localized swelling, either superficial or deep, will generally be present, in which fluctuation may be detected. *Treatment.*—Early and free evacuation of the pus.

RUPTURE OF THE VISCERA.—The rupture of an abdominal viscus is always a most serious accident, and one which is frequently, though not invariably, fatal. *Cause.*—Generally a severe crush of the abdomen, as between the buffers of railway cars; or a kick or blow, or the passage of a wheel over the abdomen. *Pathology.*—Any of the viscera, except perhaps the pancreas, may be ruptured; but the liver, intestines, and bladder are those most frequently injured. In rupture of the liver and spleen severe hæmorrhage into the peritoneal cavity, followed by peritonitis, ensues, unless the peritoneal covering escapes rupture, when no blood is extravasated. In rupture of the stomach, gall-bladder, and intestines their contents escape into the peritoneal cavity, setting up rapidly-fatal peritonitis, though in the case of the stomach and gall-bladder the more immediate danger is death from shock. Rupture of the intestine usually occurs where the duodenum joins the jejunum. The large intestine is rarely injured in consequence of its protected position. Rupture of the kidney is a less fatal accident, as the organ lies well behind the peritoneum; but when the crush is severe it may be attended with hæmorrhage or peritonitis. It is liable to be followed by perinephritic abscess. For rupture of the bladder, see *Injuries of the Pelvis.*

The *signs* of a ruptured viscus are often obscure, but great shock, extreme collapse, and intense localized pain, together with the history of a severe crush, &c., of the abdomen, point to such an injury having occurred. Beyond a surmise, however, that one of the viscera has been injured, it may be quite impossible to localize the mischief. The following signs may serve to indicate the probable nature of the lesion; thus:—1. In rupture of the liver there may be pain in the right hypochondrium, perhaps a fracture of the ribs over the liver, symptoms of internal hæmorrhage, increase of the hepatic dulness in consequence of blood-extravasation, and later peritonitis, jaundice, and very occasionally diabetes. When the rupture is slight, or the peritoneal covering is not torn, the injury may remain unsuspected and the patient recover. Or after a few days the peritoneal covering may give way and peritonitis ensue. 2. In rupture of the spleen the signs are similar, save that the pain is referred to the left side, and there may be increase of the splenic dulness, and perhaps fracture of the ribs in that region. 3. Rupture of the stomach is attended with extreme collapse, and if not rapidly fatal, with intense pain in the region of the stomach, and vomiting of blood, followed by peritonitis. 4. In rupture of the intestines, in addition to the intense pain radiating over the abdomen, there may be vomiting, first of the contents of the stomach, then of bile, and then of altered blood; blood in the stools; tympanites with dulness in the flanks; and, later, peritonitis. 5. When a kidney is ruptured there will probably be a history of a blow or other injury of the loin, increased frequency of micturition, blood-stained urine, urinary extravasation in the loin, pain and signs of bruising in the lumbar region, retraction of the testicle, and, later, pus in the urine, and signs of deep-seated suppuration (*perinephritic abscess*) or peritonitis.

Treatment.—Whatever viscus is ruptured, perfect rest, and the administration of opium, or subcutaneous injections of morphia, are imperative. In rupture of the liver, spleen, or kidney, ice may be applied over the part, and gallic acid or ergot given internally to restrain the hæmorrhage. Stimulants must be avoided, but fluid nourishments should be administered in very small quantities at a time. In rupture of the stomach or intestines the abdomen should be opened, the rent sewn up by a Lembert's suture, and the peritoneal cavity thoroughly cleansed by irrigation with a weak antiseptic solution. Subsequently the patient should be kept under the influence of opium, and nothing whatever be given by the mouth for the first few days. Nutrient enemata, if the strength flags, should be administered. In rupture of the kidney an incision in the loin or nephrectomy may become necessary.

WOUNDS OF THE ABDOMEN may be divided into the penetrating and non-penetrating, according as they do or do not involve the peritoneal cavity.

NON-PENETRATING WOUNDS should be treated like wounds in other situations, especial care, however, being taken to establish a good drain, as should they extend deeply they are apt to be complicated by effusion of blood or suppuration in the sub-peritoneal tissue. They are liable to be followed by ventral hernia.

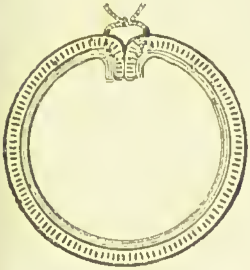
PENETRATING WOUNDS are such as involve the peritoneal cavity. They may be divided into the following:—1. Simple penetrating wounds without injury or protrusion of the viscera. 2. Penetrating wounds with injury, but without protrusion of the viscera. 3. Penetrating wounds with protrusion, but without injury of the viscera. 4. Penetrating wounds with both protrusion and injury of the viscera.

1. SIMPLE PENETRATING WOUNDS WITHOUT INJURY OR PROTRUSION OF THE VISCERA.—When the wound is large there will usually be no difficulty in ascertaining the fact that the viscera have escaped injury. If, however, the wound is very small—a mere puncture, or made obliquely, it may be difficult or impossible to say whether any injury to the viscera has been done, or, indeed, whether the abdominal cavity has been penetrated. In such a case it has hitherto been taught that the wound should on no account be probed for the purpose of settling the point, but the patient treated as if the wound had penetrated, and had not injured the viscera. If all antiseptic precautions are taken however, it is questionable whether the safer course is not to thoroughly explore the wound, not only by probing but by enlarging it if necessary, so as at once to ascertain whether it has penetrated the peritoneum, and whether the viscera have escaped injury, and not to wait till the diagnosis is settled by the onset of peritonitis. *Treatment.*—Large wounds should be cleansed with some antiseptic lotion, and united with china-silk sutures, which should be passed through the peritoneum as well as the edges of the wound so as to bring the two free surfaces of the serous membrane into contact. If this is not done the discharge from the deep part of the wound will make its way into the peritoneal cavity and set up peritonitis. In the case of punctured wounds it has usually been the custom to merely close them and apply some antiseptic dressing. As a rule, however, it will probably be safer to enlarge them, and, having ascertained that the viscera have escaped, to treat them as described above. In any case the patient should be

placed at absolute rest in bed, his diet restricted to small quantities of iced milk for the first few days, and opium given in small doses. Should peritonitis supervene it must be treated as described under that head.

II. PENETRATING WOUNDS WITH INJURY, BUT WITHOUT PROTRUSION OF THE VISCERA.—When the wound is large, and the injured viscus can be seen, the nature of the injury will probably be obvious. When, however, the wound is small, unless there be an escape externally of fæces, gas, bile, urine, or the contents of the stomach, there are no primary signs, with the exception perhaps of emphysema about the wound, absolutely diagnostic of a viscus having been injured. Intense pain, and extreme collapse, if present, no doubt point to such an injury having probably occurred; but both pain and shock are so variable as really to afford little guidance. Later the presence of tympanites and the escape of blood from the anus make it highly probable the intestine has been wounded. Recently in a doubtful case of wound of the intestine the rectum was inflated with hydrogen; the gas escaped through the rent into the peritoneum and thence through the external wound, where it ignited on applying a light, thus settling the diagnosis. Any of the viscera may be implicated; but wounds of the liver, gall-bladder, spleen, and stomach, are much less common than wounds of the intestine. The danger to be apprehended is hæmorrhage in the case of the liver or spleen, extravasation in the case of a hollow viscus, and in all, peritonitis. The amount of extravasation will depend upon the size of the wound, and whether the viscus was distended or empty at the time of injury; when the wound is a mere puncture, there may be none. If the extravasation is but slight, or escapes externally through the wound in the parietes, it may be cut off from the general peritoneal cavity by a local peritonitis, and the patient recover. An extensive extravasation is always followed by diffuse septic peritonitis, which, unless surgical measures are undertaken, will certainly prove fatal in a few days. *Treatment.*—1. If the wound in the parietes is extensive, the injured viscus, if the *stomach* or *intestines*, should be drawn gently through the aperture in the parietes and the wound of its coats united by suture, the peritoneal cavity carefully cleansed from all extravasation, and the external wound closed. Should the intestine be torn completely across, it may still be united with sutures; but if its coats are much lacerated, it will be a question whether the lacerated portions should be removed with a wedge-shaped piece of the mesentery and the two ends united, or whether it should be stitched to the abdominal parietes, and an artificial anus made. If the *liver* is wounded an attempt may be made to unite the peritoneal surface by suture, or if the wound is deep it may be plugged with iodoform-gauze and the wound in the parietes be left open above for the purposes of drainage and the subsequent removal of the plugs. If the *gall-bladder* is penetrated the wound should be sewn up, or the edges of the wound if lacerated stitched to the abdominal parietes, or the gall-bladder removed. If the *spleen* is injured extirpation of the organ appears to be the best method of arresting the otherwise fatal hæmorrhage. After the wounded viscera have been treated in one or other of the ways described above, the peritoneal cavity should be thoroughly cleansed of all blood and other extravasation by irrigation with some warm and weak antiseptic solution, and the wound in the parietes closed as after a simple penetrating wound. 2. If the wound in the parietes is small, the safer course is probably to enlarge the wound, and treat the wounded viscus as described above. The *general treatment* consists in the administration of opium; abstinence from all nutriment taken by the mouth for the first two or three days, and subsequent feeding with small quantities of iced milk, and nutrient enemata. Absolute rest is imperative. Should peritonitis supervene, it must be treated as described under that head.

Method of uniting wounded intestine.—If the wound is small (a mere puncture) it has usually been taught that no suture will be required, since the mucous membrane will protrude, block up the wound, and prevent extravasation until the wound has been healed by inflammatory exudation from the peritoneal surface. Gross's experiments on dogs show, however, that the protrusion of mucous membrane is not always sufficient even in minute wounds to prevent the escape of fæcal matter. It would, therefore, appear to be the better practice in all cases to sew up the wound, whether large or small. This is now usually done by interrupted sutures, the two peritoneal surfaces being placed in contact. The sutures are best applied by Lembert's method, as shown in the accompanying diagram (Fig. 99), in which it is seen that the suture passes through the peritoneal and muscular coats only, avoiding the mucous membrane, since if this is included there is danger of peritonitis from leakage along the thread. The sutures, which may consist of fine China silk properly carbolized, should be introduced about two lines from the edge of the wound and brought out at the margin of the serous coat, and then passed in the same manner on the opposite side (Fig. 100). If, however, the edges are lacerated the sutures should be introduced further from the wound, and brought out a good line from the margin, so as not to include the bruised



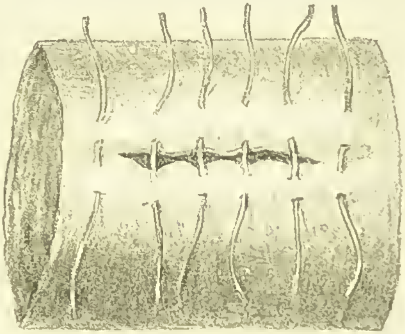
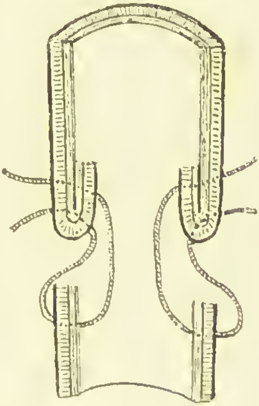


Fig. 99.—Section of intestine united by Lembert's suture.
Fig. 100.—Intestine united by Lembert's suture.



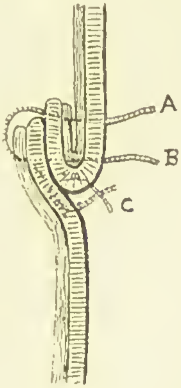


Fig. 101.—Diagram of two portions of intestine with Jobert's suture *in situ*. (After Erichsen.)

Fig. 102.—Diagram of two portions of intestine united by Jobert's and Lembert's suture. A. B. Jobert's suture; C. Lembert's suture at angle. (After Erichsen.)

tissues. Sufficient sutures should be passed to ensure the parts being everywhere in apposition, and should not be tied too tightly, lest gangrene, the commonest cause of non-union, ensue. The peritoneal surfaces thus placed in contact unite by adhesive inflammation. The sutures either remain encysted, or ulcerate through the mucous membrane, and drop into the interior of the bowel. The continuous suture formerly advised should not be used, as, if one stitch gives way, the whole will become loose, the wound gape, and extravasation occur. Where the intestine is completely divided the two portions may be united with their peritoneal surfaces in contact by Jobert's (Figs. 101 and 102), or better by Lembert's suture, or they may be united round only half their circumference, and the remaining portions sutured to the wound in the parietes, thus forming an artificial anus. In applying Lembert's method to the completely divided intestine, the sutures should first be introduced at the mesenteric attachment. At this spot there is a triangular interval formed by the divergence of the two layers of the mesentery, and, unless the suture is passed deeply, the muscular coat will be missed and extravasation occur.

III. Penetrating wounds with protrusion but without injury of the viscera.—The protruding viscus is nearly always a portion of intestine or omentum. It should be cleansed with weak antiseptic lotions, and returned by gentle uniform pressure into the abdomen, taking care not to force it between the peritoneum and fascia transversalis. If the wound of the parietes is too small to allow the viscus to be returned easily, it should be cautiously enlarged. The wound should then be closed in the way already described. If the portion of intestine is congested or inflamed, it should still be replaced. If gangrenous, however, it should on no account be returned, but left *in situ*, an incision made into it, and an artifical anus thus formed. Under some circumstances, as when near the stomach, it will be a question whether the gangrenous piece should not be cut out and the ends united, as described above, and replaced in the abdomen. A congested portion of omentum should be ligatured and cut off, and the stump returned; a gangrenous portion should be cut off, and the stump, which is probably already adherent, left in the wound. The general treatment should be the same as that before described.

IV. PENETRATING WOUNDS WITH BOTH PROTRUSION AND INJURY OF THE VISCERA.—The protruded viscus is nearly always a portion of the small intestine. The wound should be united by suture in the way already described, and the intestine then replaced. If the intestine is completely divided it may either be united by suture and returned, or an artificial anus made.

TRAUMATIC PERITONITIS may be set up by any of the injuries above described, and may either remain localized as a simple inflammation to the neighbourhood of the wound or other injury, or, as is more frequently the case, may become diffused over the whole peritoneal cavity, when it generally assumes a septic character, and terminates in blood-poisoning from the absorption of the chemical products of putrefaction.

The *simple localized variety*, after gluing the parts together, and thus preventing the spread of the inflammation, usually subsides; but it may terminate in suppuration and the formation of a circumscribed abscess, which may burst externally, into the intestine, or into the general peritoneal cavity, then setting up diffuse peritonitis. The *diffuse variety* is generally due to extravasation of urine, blood, bile, or the contents of the stomach or intestine, or the breaking of an abscess into the peritoneal cavity; and when there is an open wound, or a wound or rupture of the bladder, stomach, or intestine, it generally assumes a septic character. It usually terminates fatally, sometimes in a few hours, usually within a week or ten days, either from collapse, or from blood-poisoning due to the absorption of septic products. Should recovery occur, death may subsequently ensue from intestinal obstruction consequent upon the gluing together of the intestines or the strangulation of a loop by a band of adhesion.

Symptoms.—In the *local form* there is severe pain at one part of the abdomen increased on pressure, on deep inspiration, and on coughing, with perhaps vomiting, and a slight rise of temperature, followed should an abscess form by a circumscribed swelling, rigors, and fever. In the *diffuse variety* the pain, which at first may be localized to the seat of wound or injury, becomes general and of a lancinating character, and so increased by the slightest pressure that the weight of the bedclothes in a severe case cannot be borne. The patient lies on his back with his legs drawn up to relax the abdominal parietes, his breathing being entirely thoracic. The abdomen is at first hard owing to the spasmodic contraction of the muscles, but soon becomes distended and tympanitic, the paralysis of the muscular coat of the intestines allowing them to become inflated with gas. Later, as effusion occurs, the abdomen becomes dull in the flanks. The general symptoms are obstinate vomiting, complete constipation, hiccough, a furred, dry, and brown tongue, and a small, quick, and wiry pulse. The temperature may register 103° or 104°, but it generally falls before death, or may remain little, if at all, raised throughout.

The *treatment* may be divided into the preventive and the curative. Preventive treatment consists in the prompt removal, where practicable, of the conditions which, if allowed to continue, are virtually certain to be followed by inflammation; and subsequently in keeping the patient at absolute rest and allowing nothing to be taken by the mouth save small quantities of ice. By most Surgeons opium in small and repeated doses is given. Mr. Tait, however, on the first signs of peritonitis, orders a turpentine enema and a saline purgative, with a view of causing the absorption of any serum that may have collected in the peritoneum. Where the abdomen has been closed, as after an ovariotomy, the wound may at times be opened with advantage, and the peritoneum washed out and a glass drainage-tube inserted. In the way of curative treatment the only chance for the patient where the inflammation depends on such causes as those above mentioned, is at once to freely open the abdomen, deal with any wounded viscus in the way already described, thoroughly cleanse the peritoneal cavity, and establish a free drain. Beyond this little can be done save keeping the patient well under the influence of opium, and supporting the strength by nutrient enemata, and fluid nourishments given by teaspoonfuls at a time. In the local variety, leeches followed by hot fomentations and turpentine stupes, may be employed, whilst, should suppuration occur, the pus should be cautiously let out.

INJURIES OF THE PELVIS.

FRACTURES OF THE PELVIS.—*Cause.*—Nearly always severe and direct violence, as the passage of the wheel of a heavy van, or a crush between the buffers of railway carriages. The acetabulum, however, especially in old people, may be fractured from a fall on the great trochanter, or its rim may be chipped off in conjunction with dislocation of the hip.

State of the parts.—The injury may be localized to the acetabulum, or to the ramus of the pubes or ischium; or merely the anterior superior iliac spine or the crest of the ilium may be splintered off. When the result of a crush, the injury is generally more severe, the line of fracture often extending through the ramus of the pubes or ischium, and thence backwards through the ilium near the sacro-iliac synchondrosis, thus detaching, as it were, one side of the pelvis from the other. Or the fracture, as shown in Fig. 103, may extend in various directions, more or less smashing both the false and true pelvis. The fracture owes its importance to the liability of the pelvic viscera to be injured. Thus the bladder is not infrequently ruptured; or the urethra torn across by a fragment of the pubic arch; or the rectum or intestines lacerated, when the sacrum or the venter of the ilium is implicated.

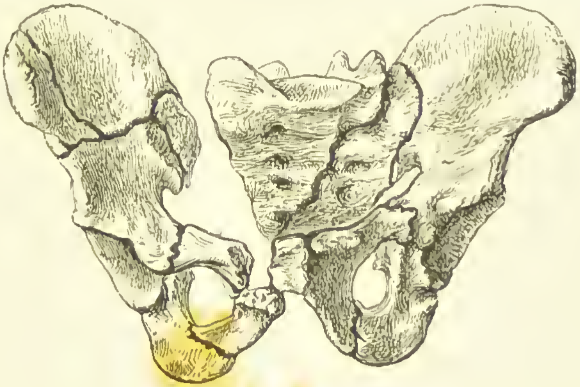


Fig. 103.—Fracture of the pelvis. (Bryant's Surgery.)

Signs.—The history of the accident, and perhaps the mark of a wheel across the lower part of the body, will commonly direct attention to the possibility of a fracture. On grasping the crests of the ilia firmly, preternatural mobility may be discovered and pain induced, whilst the patient is usually unable to walk or to turn himself in bed without great suffering. A displaced fragment may sometimes be felt through the vagina or rectum. There is usually considerable shock, and where any of the viscera have been ruptured, commonly severe collapse. (See *Rupture of Bladder, Urethra, &c.*)

Treatment.—As the bone readily unites, little beyond keeping the parts at rest and in apposition is required. This may by done by applying a flannel bandage firmly round the pelvis and confining the patient to bed for three to five weeks according to the severity of the fracture. Where there has been much crushing a gutta-percha or poroplastic felt shield should be moulded to the pelvis and hip of the affected side to prevent any movement of the fragments by the use of the joint. In any case a catheter should be passed in order to make sure that the urinary apparatus is not injured.

Fracture of the acetabulum.—A word or two in addition may be said of this form of fracture of the pelvis. The rim of the acetabulum, generally the posterior and upper part, may be broken off in some forms of dislocation of the femur on to the dorsum ilii. Beside the ordinary symptoms of the dislocation, crepitus will generally be detected on manipulation, and the head of the femur will slip in and out of the acetabulum. Or the fracture may extend through the floor of the acetabulum, the head of the bone being even driven into the pelvis. Crepitus may then be detected; or the head of the bone may be immovably fixed and the limb shortened. Pain is present on movement or on attempting to stand on the limb, also, it is said, on pressing on the pubes. *Treatment.*—Extension may be made by a long splint, or by a stirrup, weight, and pulley.

Rupture of the Bladder can only occur when the viscus is full. It may then be due to a blow or kick upon the abdomen, and is a frequent complication of fracture of the pelvis. Rupture is seldom due to over-distension consequent upon urethral stricture, as the walls of the bladder are then generally thickened and thereby rendered capable of resisting the pressure of the contained urine. Under these circumstances it is generally the urethra behind the stricture that gives way.

State of the parts.—The rupture, which is usually vertical, may extend through the posterior part of the bladder, the urine escaping into the peritoneal cavity; or through the anterior part, the urine then being extravasated into the loose cellular tissue of the pelvis. In the former case, which is the more common, acute peritonitis is generally set up, and is, as a rule, fatal in a few days. In the latter, diffuse cellulitis commonly occurs, the patient succumbing either to septic poisoning from the absorption of the products of putrefaction, or to the extension of the inflammation to the peritoneum.

Signs.—Intense collapse following a blow over the abdomen or a severe injury of the pelvis, combined with the fact that on passing a catheter (as should always be done in such a case) no urine but only a little blood escapes, whilst the patient states that the bladder was full at the time of the accident, or at least that he had passed no water for several hours previously, should lead us to infer that the bladder is ruptured. The catheter, moreover, may at times be felt to be grasped by the empty bladder, and to slip through the rent in its walls; the point may then be detected more plainly than natural through the front of the abdomen, and blood-stained urine may flow. The flow, however, is not continuous but varies with respiration. If the urine has had time to collect in the peritoneum, a sensation of fluid in the abdomen may be detected on palpation. The signs, however, are not always so obvious. Thus, there may be neither collapse nor pain; or, again, on passing a catheter, several ounces of clear urine may escape owing to urine having collected in the bladder in consequence of the rent being small or blocked by a portion of intestine. If in doubt, 10 or 12 ounces of some antiseptic fluid may be injected into the bladder, when, if no rupture exists the same quantity should flow out again through the catheter. Later, symptoms of peritonitis or of pelvic cellulitis will probably supervene. Though rupture of the bladder is usually fatal, it is not necessarily so; but the prognosis, when the rupture, as is commonly the case, is intra-peritoneal, is very grave.

Treatment.—The following are the chief plans of treatment that have been adopted:—1. The retention of a soft catheter just within the bladder. 2. Washing out the bladder and adjoining portion of the peritoneal cavity with an antiseptic solution by a catheter passed through the rent in the viscus. 3. Washing out and drainage through an incision in the perinæum. 4. Opening the abdomen, sewing up the rent in the bladder, and washing out the peritoneal cavity if the rupture is intra-peritoneal. Of these methods the last, provided every care is taken to ensure perfect closure of the rent in the bladder, and thorough cleansing of the peritoneum by irrigation, holds out, in the intra-peritoneal rupture, the best prospect of success. Four cases have recently been treated successfully in this way—two by Sir William MacCormac, one by Mr. Holmes, and one by myself. In sewing up the bladder the peritoneal surfaces should be brought into contact by Lembert's sutures (Fig. 105), which should not pass through the mucous membrane. And one suture at least should be placed beyond the angles of the wound so as to prevent leakage at these spots (Fig. 104). After the rent has been closed an antiseptic fluid should be injected into the bladder to make sure that the viscus is watertight. A catheter should not be tied in, for fear of it inducing septic changes in the urine, but the patient should be made to regularly empty his bladder every four hours to guard against over-distension and the giving way of the sutures. When it is not clear whether the rupture is intra- or extra-peritoneal, the fundus of the bladder should be exposed before opening the reflexion of the peritoneum. Extra-peritoneal rupture should be treated by a free incision in the perinæum, or above the pubes, and an antiseptic drain. In any case opium should be given internally, and nothing by the mouth, for the first twenty-four or thirty-six hours. Where, however, there is extreme collapse, stimulants may be cautiously given.

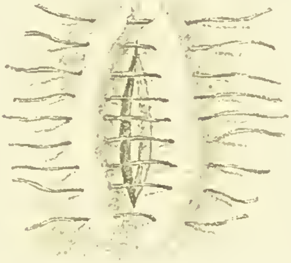


Fig. 104.—Method of applying Lembert's suture in ruptured bladder. (After Sir W. MacCormac.)

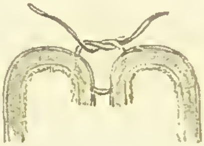


Fig. 105.—Method of applying Lembert's suture in ruptured bladder. (After Sir W. MacCormac.)

Rupture of the urethra is a serious injury, as it exposes the patient not only to the immediate danger of extravasation of urine, but also to the life-long trouble of a traumatic stricture. It is generally caused by a kick on the perinæum, a fall astride a joist or rail, or the displacement of a fragment of the pubic arch in fracture of the pelvis. The urethra may also give way behind an old stricture while the patient is straining to empty his bladder.

State of the parts.—The rupture usually occurs where the urethra passes under the pubic arch, *i.e.*, either just in front or just behind the triangular ligament. In the former situation urine and blood will be extravasated into the perinæum; in the latter, about the neck of the bladder. As the triangular ligament, however, is generally torn, some urine will, as a rule, in the latter case also pass forward into the perinæum. The urethra may be completely torn across, or the rupture may only be partial, the upper wall escaping.

The *signs* are usually quite obvious. Together with the history of an accident, there will be pain, swelling, and ecchymosis of the perinæum, and escape of blood, often in considerable quantities, from the urethra. The patient is unable to pass water, and any attempt to do so merely forces more urine into the tissues of the perinæum and gives pain. On trying to pass a catheter some obstruction is generally met with, which will often prove insurmountable; but if the catheter is finally passed, clear urine will escape. These signs distinguish it from ruptured bladder, in which injury the catheter passes easily, but as a rule (although the bladder is said to have been full at the time of the injury) only a little urine flows. In mere bruising and ecchymosis of the perinæum the catheter will pass easily, and there is, as a rule, no escape of blood from the urethra.

Treatment.—A soft catheter should be passed if possible, if not, a gum elastic or a silver one, and in any case tied in. Failing to pass a catheter, and extravasation of urine in any quantity having already occurred, a silver catheter should be passed down to the obstruction, and a free incision through the middle line of the perinæum made on its point. If the proximal end of the torn urethra can now be found, the catheter should be passed through it into the bladder and tied in. If not readily discovered, a prolonged search for it need not be made, as with a free incision through the perinæum there is no danger of further extravasation of urine. If the urethra is found only partially torn across, it has been proposed to unite it by suture and close the perinæal wound, but such a procedure is attended with some risk of extravasation, and could hardly be done where extravasation had already occurred, on account of the softened condition of the tissues. Should a fragment of the pubic arch be found compressing the urethra, steps must be taken to remove it, the bladder in the meantime being aspirated above the pubes to prevent further extravasation occurring. A silver catheter, as the point of this is more under control than that of a soft one, should be passed daily during the healing of the wound, and the patient enjoined to pass one for himself at frequent intervals, and warned that if he neglects to do so a stricture will gradually form.

INJURIES OF THE RECTUM occasionally occur from falls upon sharp-pointed bodies, or incautious attempts to pass a long enema-tube or bougie. Should the peritoneal cavity be perforated, death is the almost invariable consequence. If any injection has been thrown into the peritoneum before the mistake is discovered, opening the abdomen, sponging out the peritoneum, and sewing up the rent in the gut, probably holds out the only chance of escape.

FOREIGN BODIES IN THE RECTUM.—Foreign bodies of the most various descriptions have at times been accidentally or intentionally introduced into the rectum. Fish-bones that have been swallowed not infrequently become impacted just within the anus, there giving rise to much irritation or pain, and often causing an ischio-rectal abscess. The removal of some of these bodies, when of large size, is frequently attended with considerable difficulty, requiring an anæsthetic, dilatation of the sphincter, and the use of various forceps or even the passage of the whole hand.

INJURIES OF THE PUDENDA.—Contusions and wounds of all kinds may be met with, and require no special remark further than:—that ecchymosis of the loose cellular tissue is often extensive; that wounds, though apt to be attended with considerable hæmorrhage from the great vascularity of the parts, on this account also heal very readily; and that serious consequences from such injuries are exceedingly rare.

HÆMATOMA OF THE LABIA MAJORA sometimes occurs from injury, especially during pregnancy or parturition, the parts being congested at those times. The tumour may attain a large size, owing to the laxity of the tissues.

The blood generally becomes absorbed, but suppuration may occur or the blood become encysted. The application of ice will generally control the hæmorrhage. A hæmatoma should on no account be opened unless suppuration takes place, when a free incision will be required.

WOUNDS OF THE VAGINA perhaps more frequently fall under the care of the obstetrician than of the surgeon; the surgeon, however, may be called upon to arrest hæmorrhage from this canal, consequent upon laceration inflicted by falling upon some sharp object, or the introduction of a foreign body. The application of ice, or, if necessary, careful plugging with cotton-wool, or cotton-wool soaked in perchloride of iron, will usually suffice.

PERFORATION OF THE WALLS OF THE VAGINA, with injury of the bladder, peritoneum, or intestines, is the occasional result of wounds of the vagina, and is usually fatal.

FOREIGN BODIES IN THE VAGINA.—Pessaries that have been introduced and forgotten by the patient, or possibly without her knowledge, are the foreign bodies most frequently found in the vagina, but various other articles have at times been met with. Their long retention here is often productive of a foul-smelling discharge, and may lead to the perforation of the walls of the rectum or bladder and an incurable fistula.

FOREIGN BODIES IN THE FEMALE URETHRA AND BLADDER.—Hair-pins introduced with the bent end forwards, are not infrequently pushed up the urethra into the bladder, where, if allowed to remain, they become encrusted with phosphates, and give rise to symptoms of stone. The urethra should be dilated, and the sharp ends of the hair-pin grasped by forceps, snared in a tube, or in some such way removed.

RUPTURED PERINÆUM occasionally occurs during first, and especially instrumental labours. There may be a mere rent in the fourchette; or the rupture may extend from the vagina through the sphincter ani into the rectum, and involve more or less of the recto-vaginal septum.

Symptoms.—A rupture, when slight, gives rise to no special trouble; but when more extensive, there may be some prolapse of the posterior wall of the vagina with the contiguous wall of the rectum, or of the anterior wall of the vagina and the part of the bladder in contact with it, and, perhaps, some prolapse of the uterus. There may also be frequent micturition, and when the sphincter ani is involved, occasional incontinence of fæces.

Treatment.—An attempt to unite the parts should always be made immediately after the rupture by introducing several wire sutures. Should this fail, no harm will have been done, and a plastic operation can be subsequently performed. Such, however, should not be undertaken until the vaginal discharge has ceased, the child been weaned, and the general health restored. The patient in the meantime should not be allowed to walk about, for fear of a prolapse of the parts. The *operation* consists in refreshing the sides of the rupture, and uniting them by suture. The bowels having been cleared by an aperient, and the rectum on the morning of the operation by an enema, the patient should be placed in the lithotomy position, and the skin dissected off from the sides of the fissure, and the mucous membrane from the recto-vaginal septum, so as to leave a raw surface of the size and shape shown in Fig. 106. Care should be taken that

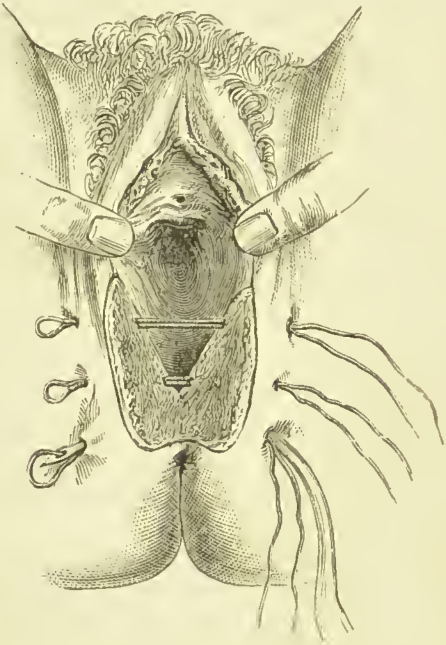


FIG. 106.—Operation for ruptured perinæum. (Bryant's Surgery.)

the tissues are clean cut, and that the raw surface of the recto-vaginal septum is at least an inch broad, so that immediate and firm union when the parts are brought together may be obtained, Three deep sutures, consisting of thick silver-wire, strong silkworm gut, or China twist, should be introduced by means of a perinæal needle. The first should be passed about an inch from the margin of the rupture deeply through the recto-vaginal septum, and out at the corresponding spot on the opposite side. The next two sutures should be passed in the same way, only not through the septum. Fig. 106 shows the appearance presented by the sutures when *in situ* and ready for tying. They may be fastened over a piece of quill or by a split shot, or simply tied, the posterior suture being first secured. Superficial sutures, after the fissure has been drawn together by the deep, should be used to keep the edges of the skin in contact. If there appears to be any tension, incisions of relief may be made through the skin on either side. The bowels must be kept confined for a week, and the bladder for the same period emptied by tho catheter. The patient should lie perfectly quiet on her back with the legs tied together, and the knees over a pillow. The deep sutures should bo removed at the end of a week, the parts in the meanwhile being kept clean by gentle syringing with an antiseptic lotion. Where the posterior or anterior wall of the vagina is much prolapsed, a wedge-shaped pieco of mucous membrane may be removed, and the edges of the incision brought together by suture. The bowels should be opened by an enema at the end of a week or ten days, and the patient should keep her bed for at least threo weeks.

INJURIES OF THE SCROTUM AND TESTICLE.—Wounds of the scrotum and penis are rare. They readily heal in consequence of their abundant blood-supply. Contused wounds of the scrotum are often attended with much extravasation of blood, giving the parts a black and swollen appearance, and are apt to be followed by sloughing. Should such threaten, free incisions must be made. Extravasation of blood into the tunica vaginalis (*hæmatocele*), and inflammation of the testicle (*orchitis*), both of which may follow a blow or other injury of the parts, are described under *Diseases of the Testicle.*

LIGATURE OF THE PENIS.—A piece of string is sometimes tied round the penis by children either in play, or to prevent themselves wetting the bed. Great swelling in front of the constriction ensues, and if the cause is not recognized and removed, the string will soon cut deeply into the penis, and may even divide the urethra.

FOREIGN BODIES IN THE MALE URETHRA AND BLADDER.—Pieces of slate-pencil, beads, and the like, are sometimes passed by boys into their urethra, and not infrequently a piece of a wax bougie, or damaged gum-elastic or black catheter is broken off during catheterization. An attempt should be made to remove the foreign body by manipulation with the fingers, or by the introduction of the urethral forceps, or by asking the patient to first close the meatus with the finger and thumb, to make a forcible attempt to pass water, and then suddenly to relax his hold. If the forceps are used, the urethra should be grasped, if practicable, behind the foreign body, lest the latter be pushed back into the bladder. Failing to remove the body by any of these means, it may be pushed back into the bladder, broken up by a lithotrite, and removed by the evacuator, or, if soft, grasped with the lithotrite and removed whole. If it cannot be pushed into the bladder, it must be cut down upon and extracted through an incision in the middle line of the urethra. *Foreign bodies in the bladder*, if allowed to remain, become encrusted with phosphates, and give rise to symptoms of stone (see *Stone in the Bladder*).

INJURIES OF THE UPPER EXTREMITY.

BRUISES, CONTUSIONS, BURNS, SCALDS, AND FROST-BITES of the upper extremity require no special remarks.

SPRAINS of the joints of the upper extremity, especially of the wrist, are very common. Rest, the `application of cold, and in the case of the thumb, wrist, or elbow, a wet bandage followed by friction with a stimulating liniment, is the usual treatment. A sprain, however, slight, should never be neglected, as inflammation in or around the joint may ensue, leading to fibrous ankylosis or to adhesion of the tendons to their sheaths. See *Sprains of Joints*, p. 175.

SPRAINS OF THE MUSCLES causing tenderness, slight swelling, and pain on movement, are not infrequently met with after hard rowing or other excessive exercise.

RUPTURE OF MUSCLES AND TENDONS, especially the pectoralis major and the long tendon of the biceps, are not uncommon accidents. The latter may occur during any sudden involuntary action, and may be known by sudden pain, loss of power, and a gap in the course of the long tendon, whilst the inner head, on putting the muscle into action, forms a prominent lump. Little or nothing can be done in the way of treatment.

WOUNDS of all kinds are very common. Wounds of the palm only need special comment.

WOUNDS OF THE PALM are frequently attended with severe and troublesome hæmorrhage from either the superficial or deep arch. When the wound is clean cut the bleeding vessel may be tied in the usual way; but when the wound is of a punctured character such an attempt would inflict severe injury on the tendons and nerves in the palm. A graduated compress in this case should be put on, the hand bandaged over an ordinary roller, pressure applied to the ulnar and radial arteries at the wrist, and the forearm flexed forcibly on the arm to control the flow of blood through the brachial artery. The compress should be kept on for about a week. If this fails, or if the patient is not seen until the palm has become infiltrated and sloughy, the brachial artery should be tied. The anastomosis through the interosseous and carpal arteries is so free that ligature of the radial and ulnar is not, as a rule, sufficient to stop the bleeding.

NEEDLE IN THE PALM.—It is not infrequent for a needle to run into the hand and be broken off. If it can be felt it should be cautiously cut down upon and extracted with forceps, care being taken not to push it in further, and so lose it in the attempt. If it cannot be felt, an exploratory incision should on no account be made, as the needle will probably do no harm in the tissues and in course of time will work it's way to the surface, whilst a search for it may be attended with irreparablo damage. A galvanometer has occasionally been used for its discovery with success.

IN SMASHES OF THE HAND requiring operative interference, the thumb and as many fingers, indeed as much of the hand as possible, should be saved.

Dislocations of the Upper Extremity.

DISLOCATIONS OF THE CLAVICLE.—I. The *sternal end* may be dislocated, 1, forwards; 2, upwards; and, 3, backwards. *Cause.*—The forward and the upward dislocations are produced by indirect violence, such as a blow or fall upon the *front* or *top* of the shoulder; the backward variety either directly by force applied to the sternal end, or indirectly by a blow or fall on the *back* of the shoulder. *Displacement.*—In the *forward* dislocation the end of the bone lies in front of the sternum, in the *upward* it lies in the suprasternal notch touching the opposite clavicle, in the *backward* between the sternum and the trachea. *Signs.*—In the forward dislocation (Fig. 107) the end of the bone can be felt in its abnormal situation, and can be distinguished from fracture near the sternal end by the length of the clavicle being the same on the two sides, and by the absence of crepitus. The upward variety, which is very rare, may be diagnosed in the same way. In the backward, which is also rare, there is a depression at the situation of the sterno-clavicular joint, and there may be dyspnœa, dysphagia, or congestion of the head and face from pressure on the trachea, œsophagus, or veins of the neck. *Treatment.*—The forward and the backward dislocations can generally be readily reduced by simply drawing back the shoulders, the knee, if necessary, being placed between the scapulæ. In the forward variety, indeed, I have always found the end of the clavicle sink into its place on laying the patient on his back. Reduction of the backward variety has at times been impossible, and excision of the end of the bone has been necessary for the relief of the severe dyspnœa which it has caused by its pressure on the trachea. The upward dislocation may be reduced by placing a pad in the axilla to act as a fulcrum and pressing the arm to the side, thus drawing tho clavicle

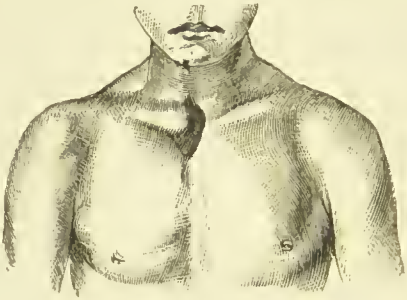


Fig. 107.—Dislocation of the sternal end of the clavicle forwards. (Bryant's Surgery.)

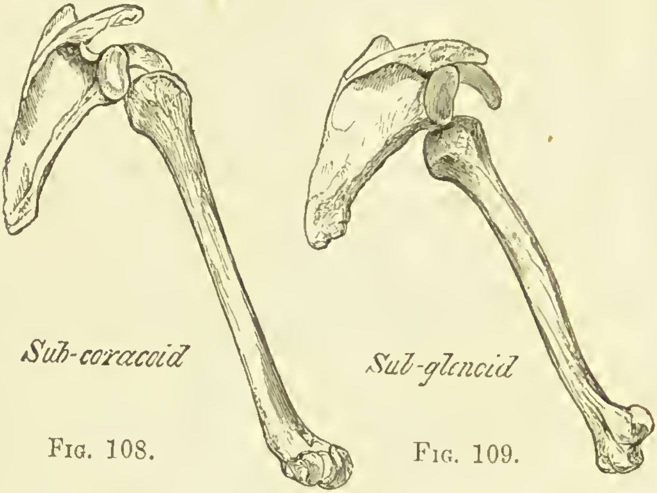
outwards. Direct pressure should at the same time be applied to the displaced end. All forms are difficult to retain in position. The best plan, perhaps, is to keep the patient constantly on his back for three weeks. If, however, he will not consent to this restraint, an endeavour may be made to retain the parts in as good a position as possible by one of the many methods of bandaging described in the larger text-books. I do not mention any here, as I have never seen any of them of any avail.

II. The *acromial end* may be dislocated either, 1, upwards; or, 2, downwards. Both forms are rare, but the upward is the least so. These injuries are sometimes spoken of as dislocations of the scapula. *Cause.*—Commonly direct violence applied to the acromion. The *signs* are usually obvious. There is apparent lengthening of the arm with depression and slight flattening of the shoulder, and a projection in the region of the acromio-clavicular joint caused, in the *upward* form, by the acromial end of the clavicle, and in the *downward* by the acromion process. In the upward variety moreover the end of the trapezius stands out as a prominent ridge, and on pressing with one hand on the shoulder and with the other on the elbow the articular surfaces are brought into apposition and pseudo-crepitus can be obtained. *Reduction* is as a rule easily effected by drawing the shoulders well backwards; but it is difficult to retain the bones in position in consequence of the peculiar obliquity of the articulation. This may be attempted by placing a pad over the joint and applying a strap or a bandage over the shoulder and under the elbow, and then bandaging the arm to the side. I have seen the best results from rest in the horizontal position for three weeks; few patients, however, will submit to this, nor is it possibly worth their while to do so, as little inconvenience attends the dislocation, though unreduced.

DISLOCATION OF THE SHOULDER is very common, a fact explained by the shallowness of the glenoid cavity, the large size and rounded shape of the head of the bone, the looseness of the capsule, and the powerful leverage exerted on the joint by the arm in protecting the body in falls, &c. It is most frequent in the old and middle-aged, rare in the young, and more common in men than in women.

Cause.—Falls or blows directly upon the shoulder; falls on the elbow or hand with the arm extended; forcible twists of the arm; and occasionally muscular action.

Varieties.—Dislocations of the shoulder may be classified according to the position of the head of the humerus into.—1, forwards and slightly downwards (*subcoracoid*);



Sub-coracoid

Fig. 108.

Sub-glenoid

Fig. 109.

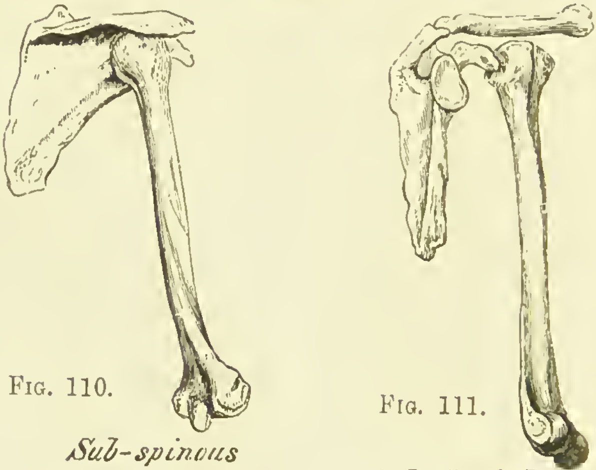


Fig. 110.

Sub-spinous

Fig. 111.

Sub-clavicular

Figs. 108, 109, 110, 111.—Various forms of dislocation of the humerus. (Professor Flower's models.)

2, downwards and slightly forwards (*subglenoid*); 3, backwards (*subspinous*); and 4, forwards (*subclavicular*) (Figs. 108, 109, 110, and 111). An upward dislocation (*subacromial*) has been described, but this form of displacement is more generally believed to be the result of chronic osteo-arthritis. Other and rarer varieties have also been described, but appear to be merely modifications of those above enumerated.

The *signs* common to all the varieties in addition to the ordinary signs of dislocation, viz., pain, swelling, immobility, and absence of crepitus, are—1, flattening of the shoulder; 2, prominence of the acromion; 3, a depression beneath the acromion, increased when the arm is raised; 4, a change in direction of the axis of the humerus; and 5, the absence of the head of the bone from the glenoid cavity and its presence in an abnormal situation. In doubtful cases the following tests will be found of use:—1, *Hamilton's test.* A straight edge applied to the outer side of the arm, can only be made to touch the acromion and external condyle at the same time when the head of the humerus is absent from the glenoid cavity; 2, *Callaway's test.* A tape passed round the acromion and under the axilla will measure about two inches more on the dislocated than on the sound side; 3, *Dugas's test.* With the hand placed on the opposite shoulder, the elbow in a dislocation cannot be made to touch the chest. Occasionally a dislocation is complicated by a fracture, and an accurate diagnosis may be rendered very difficult. In such, and in all cases where there is any doubt, the patient should be examined under an anæsthetic.

The subcoracoid.—This is the most frequent variety of dislocation of the shoulder (Fig. 108). The head rests on the anterior surface of the neck of the scapula, just below the coracoid process, the groove between the head and greater tuberosity resting on the anterior margin of the glenoid cavity. The capsular ligament is lacerated anteriorly and inferiorly, or detached from the margin of the glenoid cavity in front and below. The subscapularis is generally raised by the head of the bone from the scapula, and the supraspinatus, infraspinatus and teres minor are tightly stretched. Sometimes the muscles are torn across at their insertion, or the greater tuberosity is detached, the muscles remaining entire. Under these circumstances the head of the bone rolls inwards so that more of it is internal to the coracoid process, a condition described by Malgaigne as a distinct variety (*intracoracoid*). The long head of the biceps is generally uninjured, whilst the short head and the coraco-brachialis and the axillary artery and brachial plexus are displaced inwards by the head of the bone. *Special signs.*—The head of the bone can be seen and felt in its abnormal situation. The elbow projects slightly backwards and away from the side. The arm is generally shortened or unaltered in length; occasionally it is said to be lengthened. The truth appears to be that there are all grades between the subcoracoid as here described in which there is undoubted shortening, and the next form, the subglenoid, in which lengthening as undoubtedly occurs.

The subglenoid is the next most common variety. The head rests on the inner aspect of the inferior border of the scapula, below and a little in front of the glenoid cavity (Fig. 109). The capsular ligament is ruptured below. The supra- and infra-spinatus, teres minor, and subscapularis may or may not be torn. The circumflex nerve is especially liable to be compressed, producing temporary or even permanent paralysis of the deltoid. The *signs* are similar to those of the subcoracoid, but there is greater flattening of the shoulder, more prominence of the acromion, and a more marked depression under it, and the elbow points neither backwards nor forwards. The diagnostic marks are:—1, great depression of the anterior fold of the axilla; 2, presence of the head of the bone in the axilla; 3, lengthening of the arm; 4, an interval of from one to two inches between the coracoid process and the head of the bone.

The subspinous.—This variety is rare. The head rests on the dorsum of the scapula beneath the spine (Fig. 110). The capsular ligament may or may not be ruptured. The infraspinatus is generally torn up from the bone, and the subscapularis and supraspinatus are either stretched or ruptured according to the amount of displacement. The teres minor is relaxed, and the long tendon of the biceps stretched or displaced out of its groove. *Special signs.*—There is great flattening of the shoulder, the elbow points forwards, the forearm is in front of the chest in consequence of the inward rotation of the humerus, and the head of the bone can be felt in its abnormal situation, but not in the axilla.

The subclavicular is very rare. The head rests beneath the clavicle, internal to the coracoid process (Fig. 111). The capsule is generally extensively lacerated at its inner side. The pectoral muscles are raised by the head of the bone, which rests on or between the fibres of the subscapularis. The latter muscle is torn up from the subscapular fossa, but retains its connection to the humerus. The supra- and infraspinatus are generally torn across, or detached from the humerus, but may retain their connection to the capsular ligament. The teres minor is not torn. *Special signs.*—The head of the bone forms a distinct prominence below the clavicle, and the shaft only can be felt in the axilla. The arm is pressed tightly to the chest and the elbow projects backwards.

Diagnosis.—A dislocation of the shoulder may have to be diagnosed from a fracture of the neck of the humerus, separation of the upper epiphysis, fracture of the neck of the scapula, fracture of the glenoid cavity, and from simple sprains and contusions of the joint attended with more or less paralysis of the deltoid. Attention to the general and special signs of dislocation as above given, together with the absence of crepitus and other signs of fracture, will generally make the diagnosis easy; but where the patient is very muscular, or there is much swelling, or manipulation causes excessive pain, an anæsthetic should be given, and a thorough examination made. It should not be forgotten that crepitus may be simulated by effusion into the joint and sheaths of the surrounding tendons. True bony crepitus having been once felt, however, can hardly be mistaken for this.

Treatment.—The difficulty in reducing a recent dislocation consists in 1. Overcoming muscular contraction; and 2. Re-introducing the head of the bone through the hole in the capsule. In long-standing cases there are additional impediments to reduction, viz., 3. The formation of adhesions around the joint. 4. Alteration in the shape of the head of the bone; and 5. The obliteration of the old cavity. Manipulation should first be tried, if necessary, under an anæsthetic, and if this fails, extension should be made with the knee or heel in the axilla, and finally with the pulleys. 1. *Manipulation.*—Many methods have been devised, some of which are not unattended with danger, as the axillary artery has been torn or ruptured in their use. The following method is now generally employed at St. Bartholomew's, and has been attended with excellent success. Place the patient in the horizontal position; flex the elbow; rotate the humerus outwards as far as possible without using excessive force, then carry the elbow across the chest, at the same time rotating the humerus inwards. Another method consists in slowly abducting the arm to the level of the shoulder or above.

2. *Extension.* (Fig. 112).—Place the patient on his back; seat yourself on the edge of the couch; draw the arm slightly from the side; place your heel without your boot well in the axilla, and grasping the wrist, make steady extension on the arm, whilst the heel fixes the scapula and presses the head of the bone outwards. The head of the bone will probably be felt after a few minutes to slip into its place with an audible snap. Should it not do so, secure a jack towel with a clove-hitch (Fig. 113) to the arm, and increase the extending force by getting an assistant to pull on it with you at the same time. The direction of the force may be slightly varied from time to time, and the humerus gently rotated. Where extension with the heel in the axilla fails, slowly carry the arm to a right angle with the body and extend, or raise it above the head, and again extend in this position. An anæsthetic should be given if necessary. 3. *Extension with the pulleys.*—In long-standing cases the use of the pulleys may be required. First break down any adhe-

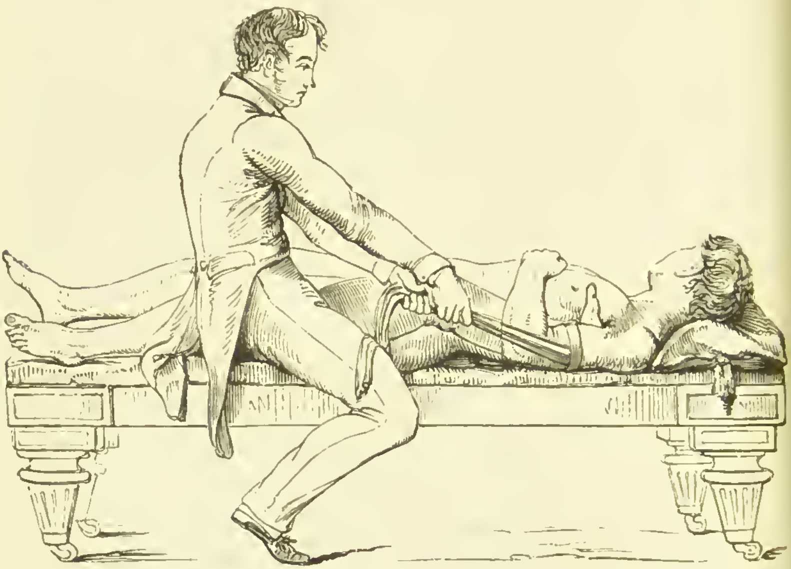


Fig. 112.—Reduction by the heel in the axilla. (Cooper's Dislocations.)

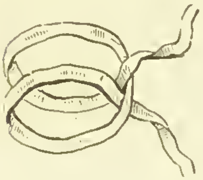


Fig. 113. — The clove-hitch.

sions that may be present, by cautiously manipulating the arm; then fix the scapula by a well-padded leather strap passed under the axilla and secured to a staple in the wall. Attach the pulleys to a leathern band buckled round the arm, and make steady extension, manipulating the head of the bone the while. The extension and counter-extension should always be made in the same horizontal line. This may be first in the direction of the axis of the body, then across the body, with the arm at right angles to it (Fig. 114). Occasionally success may be obtained by suddenly relaxing the extension after it has been applied for a few minutes, endeavouring at the same moment to manipulate the head into its place. Although the direction of the force appears to vary in the different methods of extension, it is probable that in consequence of the mobility of the scapula, it is nearly

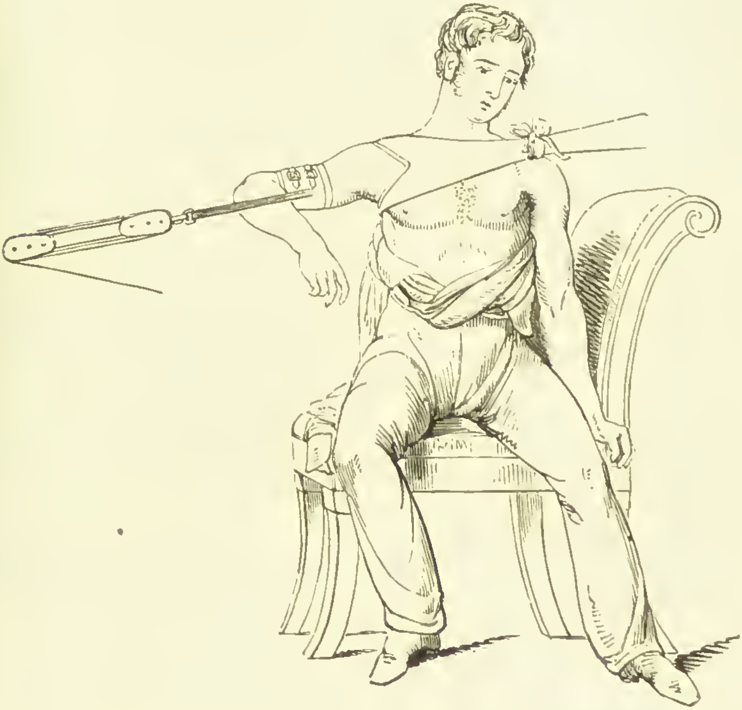


FIG. 114.—Reduction with the pulleys. The patient though here shown sitting, should as a rule be placed in the recumbent posture, as an anæsthetic is generally required. (Cooper's Dislocations.)

always applied perpendicularly to the plane of the glenoid cavity.

After-treatment.—A pad should be placed in the axilla and the arm carefully bandaged to the side with the forearm across the chest, and the hand on the opposite shoulder. Passive movements of the joint should be begun about the end of a week and practised once or twice daily, but the arm should be bandaged to the chest in the intervals for upwards of three weeks, and subsequently used with great caution for several months to prevent redislocation.

How long after a dislocation of the shoulder has occurred does it admit of reduction? Sir Astley Cooper fixed the limit at three months, but cases are reported in which it is said to have been accomplished two years after the accident. It should be remembered, however, that as in unreduced dislocations a new cavity is gradually formed for the head of the bone whilst the old cavity is filled up, reduction sooner or later becomes a physical impossibility. Still, where the arm is very stiff, although reduction may not be accomplished, the range of motion in the false joint may be considerably improved by the attempt. On the other hand, where the motion is fairly free, the injury inflicted in an attempt at reduction may counterbalance any advantage gained.

Risks that may attend reduction of long-standing cases.—1. Rupture of the axillary artery or vein; 2. Injury of the brachial plexus of nerves; 3. Fracture of the neck of the humerus; 4. Fracture of the ribs; 5. Tearing open of the axilla; and 6. Evulsion of the arm.

Occasional ill-effects following a dislocation of the shoulder.—1. Inflammation or suppuration of the joint and ankylosis; 2. Paralysis of the deltoid or other muscles; 3. Axillary abscess; 4. Non-union of the rent in the capsule and a consequent tendency to re-dislocation on very slight violence.

Treatment of compound dislocation of the shoulder.—When the wound is small, the head of the bone uninjured, and the soft parts are neither much lacerated nor bruised, an attempt should be made to reduce the dislocation. If successful, the case may then be treated as a wound of the joint. When the head of the bone is much injured, it may be excised; whilst in severe and complicated cases, amputation at the shoulder-joint may become necessary.

The treatment of dislocation and fracture is often attended with much difficulty. As a rule the fracture if possible should be set, the arm placed in splints, and an attempt then made to reduce the dislocation. Failing in this, the separated head may sometimes be manipulated into its socket; otherwise, splints should be applied, and when the fracture has united, another trial made to reduce the dislocation.

DISLOCATION OF THE ELBOW is most frequent in the young. *Cause.*—Direct violence, or a fall on, or wrench of, the forearm or hand.—*Varieties.*—A. *Both bones* (radius and ulna): 1, backwards; 2, inwards; 3, outwards; 4, forwards; and 5, radius forwards, and ulna backwards. B. *Radius only*: 1, forwards; 2, backwards; and 3, outwards. C. *Ulna only:* 1, backwards. Of these, the dislocation of both bones backwards, and of the radius forwards or backwards, are the only common forms; the others are very rare, and will receive but a passing notice.

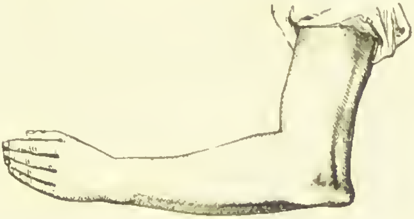


FIG. 115.—Dislocation of the radius and ulna backwards. (Cooper's Dislocations.)

Signs.—In the common form of *both bones backwards* (Fig. 115), the radius and ulna are displaced directly backwards, so that the coronoid process of the ulna rests in the olecranon fossa, and the neck of the radius on the capitellum of the humerus. The coronoid process is often fractured at the same time. The bones are frequently displaced slightly outwards, or inwards, as well as backwards—modifications which have been unnecessarily classed as distinct varieties. The forearm is partially flexed and shortened. The olecranon and head of the radius form an unnatural prominence posteriorly, and are felt at a considerable distance behind the external and internal condyles respectively. The lower end of the humerus forms a broad projection *below* the crease of the bend of the elbow. In the rarer forms of *both bones inwards* or *outwards* the prominence of the opposite condyle of the humerus on one or other side is a characteristic feature. In *both bones forwards* (exceedingly rare) the forearm is lengthened, the natural prominence of the olecranon is lost, and the condyles of the humerus are very prominent. In the *ulna backwards and the radius forwards* the arm is greatly increased in its antero-posterior diameter.

In dislocation of the radius alone whether forwards, backwards, or outwards, the head of the bone is felt to roll in its abnormal situation, in front of, behind, or external to, the external condyle on pronating and supinating the hand. The first of these forms (Fig. 116) is the most common, and in it the forearm cannot be flexed beyond a right angle, in consequence of the head of the bone striking the humerus.

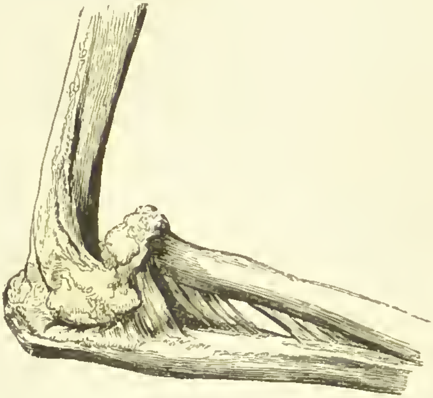


Fig. 116.—Dislocation of the radius forwards.

In dislocation of the ulna backwards the forearm is pronated and shortened on the ulnar side, and the olecranon projects backwards, but the head of the radius is felt in its normal situation.

Diagnosis.—In moderately thin subjects when seen soon after the accident, attention to the above signs will generally enable the Surgeon to make a diagnosis; but in a few hours the parts become so obscured from swelling about the joint, that it may be impossible to make out the nature of the injury till it has subsided. In all cases of injury of the elbow the relation of the points of bone to each other should be carefully compared with those of the uninjured side, and the relative position of the olecranon to the condyles should be determined (see *Fracture of the lower end of the Humerus*).

Treatment.—The reduction of the common form of dislocation of *both bones backwards* is generally easily accomplished in recent cases by pressing with the knee in the bend of the elbow on the upper part of the radius and ulna to disengage the coronoid process, whilst forcibly but slowly flexing the forearm. As soon as the coronoid process is freed from the olecranon fossa, the muscles generally draw the bones suddenly into position. Pressure upon the humerus by the knee, as recommended by some, should be avoided, as it locks the coronoid process more tightly in the olecranon fossa. If necessary, an anæsthetic should be given. In long-standing cases adhesions must be broken down by forcibly flexing and extending the forearm, and extension may then be made either by the knee, or by an assistant pulling on the wrist, or if this is insufficient, by the pulleys. Six weeks is the period usually given as the time beyond which it is inexpedient to try and reduce the dislocation. This rule, however, admits of some latitude. Thus, an attempt at reduction, when the movement is fairly good, even after less time has elapsed, may be unwise; while, on the other hand, it may sometimes be made with advantage, especially where there is much rigidity, even at a later period. In dislocation of the *radius alone*, extension should be made from the hand (so as to act solely on the radius), whilst the elbow-joint is grasped, and the head of the radius pressed into position by the thumb in a forward or backward or inward direction, according to the variety of the dislocation. In the other dislocations slight modifications of these methods are required, and will be suggested by a knowledge of the anatomy of the joint, and a correct diagnosis of the nature of the displacement.

After-treatment.—The joint should be placed on a splint and the arm in a sling, and evaporating lotions or ice applied to prevent inflammation. Passive movements should be cautiously begun about ten days or a fortnight after the injury.

Complications.—1, Fracture of (*a*) the coronoid process; (*b*) the olecranon; (*c*) the neck of the radius; (*d*) the lower end of the humerus; and (*e*) the condyles of the humerus; 2, separation of the lower epiphysis of the humerus; 3, wound of the joint; 4, laceration of the main artery; and 5, injury of the ulnar or other nerve.

Treatment of compound dislocation of the elbow.—When the patient is young, the wound small, the laceration and bruising of the soft parts but slight, and the bones are uninjured, the dislocation should be reduced, and the case treated as a wound of the joint. Otherwise excision of the joint, or, in severe cases, amputation, must be practised.

DISLOCATION OF THE WRIST is very rare. The carpus with the hand may be displaced either backwards or forwards. In the dislocation backwards, which is the more common variety, the carpus forms a projection on the dorsal surface of the wrist, whilst the ends of the radius and ulna project on the palmar surface. It resembles Colles' fracture, which was formerly confused with it. In the dislocation the styloid processes of the radius and ulna are on the normal level, and are nearer the knuckles than is natural, and there is no crepitus. *Treatment.*—Reduction is easily effected by making extension on the hand and pressing upon the displaced bones. The forearm and hand should then be secured to a splint, and passive movements begun early to prevent stiffness.

DISLOCATION OF THE LOWER END OF THE RADIUS FROM THE ULNA may be produced by a violent twist of the hand. When the twist is in the direction of pronation, the radius is displaced forwards; when of supination, backwards. The former is the more common. The hand accompanies the radius, and the styloid process of the ulna projects prominently in the opposite direction and has been sometimes forced through the skin. *Treatment.*—Whilst making extension from the hand, manipulate the bone into position and retain it there by a compress and splint.

DISLOCATIONS OF THE CARPAL AND METACARPAL BONES are very rare. Their diagnosis is usually obvious.

The *phalanges of the fingers* may be dislocated backwards or forwards. Reduction is easily effected by extension and manipulation.

Dislocation of the metacarpal bone of the thumb from the trapezium may occur in a backward or forward direction, and is easily reduced by extension or pressure.

Dislocation of the first phalanx of the thumb from the metacarpal bone is of more importance. The phalanx is nearly always displaced backwards; the shortening of the thumb and the projections of the base of the phalanx and head of the metacarpal bone serve for its diagnosis.

Reduction is often very difficult, on account of the head of the metacarpal bone being forced between the two insertions of the flexor brevis pollicis by which its neck is tightly embraced. *Treatment.*—Press the metacarpal bone well into the palm of the hand to relax the flexor brevis pollicis, and bend back the first phalanx on the metacarpal bone until the extremity of the thumb points towards the wrist, thus forcing the base of the phalanx wedge-wise between the two insertions of the short flexor. Now flex the phalanx while an assistant, by placing his thumb behind its base, prevents it slipping back. The head of the metacarpal bone will probably slide into its place between the two insertions of the flexor brevis pollicis, which are forced apart by the wedge-like action of the base of the phalanx. Reduction may sometimes be accomplished by extension, *e.g.*, by the clove-hitch, or if, at hand, by the Indian puzzle-toy or the American forceps—a method, however, less scientific than that of manipulation, and one which seldom succeeds if the other fails. As a last resource, the insertion of the flexor brevis pollicis may be divided subcutaneously, or hooked aside after the method of Professor Humphry. These means failing, the joint may be excised, or better, left alone, as very fair movement will, as a rule, in time be gained.

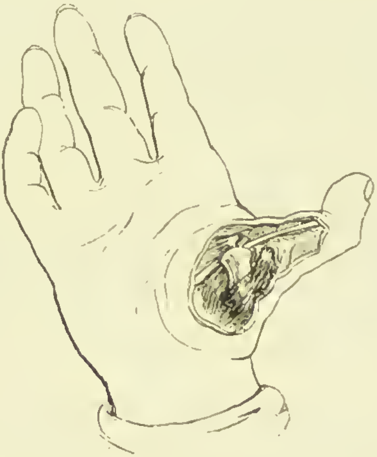


FIG. 117.—Dislocation of the thumb backwards at the metacarpo-phalangeal joint. (After Agnew.)

Fractures of the Upper Extremity.

FRACTURES OF THE CLAVICLE are divided into fractures of 1, the *shaft*, 2, the *acromial end*, and 3, the *sternal end*.

I. *The shaft* may be fractured by direct violence, or, as is more commonly the case, by indirect violence, such as a fall upon the arm or shoulder; more rarely by muscular action. *Situations.*—When the result of indirect violence or muscular action the bone is generally broken near its centre—its weakest part. When due to direct violence, the bone will break wherever the force is applied. *Nature of the displacement.*—The inner fragment, although it appears raised in consequence of the depression of the outer, is not displaced, being held in position by the sterno-mastoid and the rhomboid ligament; the outer fragment is drawn downwards, forwards and inwards by the weight of the arm and the contraction of the pectoral muscles. The *signs* in an adult are usually very evident. The inner fragment projects prominently under the skin; the shoulder droops forwards and downwards; the patient usually supports his elbow with the sound hand whilst he inclines his head to the fractured side to relax the sterno-mastoid. In a fat child, however, especially when the fracture is of the greenstick variety (Fig. 118), which it often is in children, the signs are less evident; indeed surgical aid is often not sought until the mother's attention is called to the part by the presence of a lump formed by the ensheathing callus. Union generally occurs in about three weeks in children and five in adults. *Treatment.*—The fracture is easily reduced by drawing back the shoulders, or by placing the patient in the recumbent posture; but it is very difficult to maintain the fragments in apposition. Hence the numerous bandages and apparatus that have been from time to time employed. Where it is important to avoid deformity, rest on the back for a

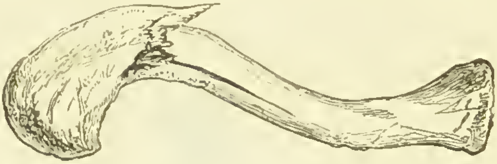


FIG. 118.—Greenstick fracture of the clavicle. (Holmes' System.)

fortnight is essential; otherwise the patient may be allowed to get about with his arm bandaged to the side, and the parts kept as much as possible in apposition by bandaging or strapping. Of the many plans the following may be tried.

1. *Sayre's method.*—Take three pieces of adhesive strapping about three inches and a half wide, and long enough to surround the arm and afterwards the body. Stitch one piece, with the adhesive surface outside, loosely round the arm on the injured side at the insertion of the deltoid muscle. Draw the arm forcibly backwards to put the clavicular portion of the pectoralis major on the stretch, and carry the strapping across the back and round the front of the thorax, and sew the end to the part which crosses the back (Fig. 119). Fix one end of the second strip of plaster to the sound shoulder; carry it obliquely across the back beneath the elbow (which should be pushed forwards) of the injured side, a slit being made to receive the olecranon; bring it upwards in front of the chest, and fasten it to its other end over the sound shoulder (Figs. 120 and 121). A third strip may be carried round the arm, forearm and thorax to keep the others in place. The first strip acts as a fulcrum; whilst the second, by drawing the elbow forwards, forces the upper end of the humerus, with the clavicle, backwards, and at the same time keeps the shoulder raised.

2. *Ellis's method* consists briefly in the use of an axillary crutch supported by two straps, the one round the chest, the other passed over the sound shoulder. The chest strap also encircles the arm and holds it firmly to the side. The forearm is further supported by a sling.

3. *The axillary pad and bandage.*—Many surgeons simply place a wedge-shaped pad with the base upwards in the axilla, and then bandage the arm to the side with the elbow well raised. If the pad is used, care should be taken in bandaging lest the axillary vessels or nerves are compressed, and œdema, pain, or even gangrene of the arm be the consequence.

II. *Fracture of the acromial end of the clavicle* may occur either internal or external to the coraco-clavicular ligaments. In the former situation there is very little displacement, the fragments being held in position by the above-mentioned ligaments. Pain, crepitus, and possibly a slight gap, will serve to distinguish it. When external to the ligaments the outer fragment is drawn down nearly at a right angle to the rest of the bone, so that its acromial articulation looks inwards, forwards, and slightly downwards. *Treatment.*—An axillary pad and bandage, with a moulded leather shoulder-cap to protect the parts.

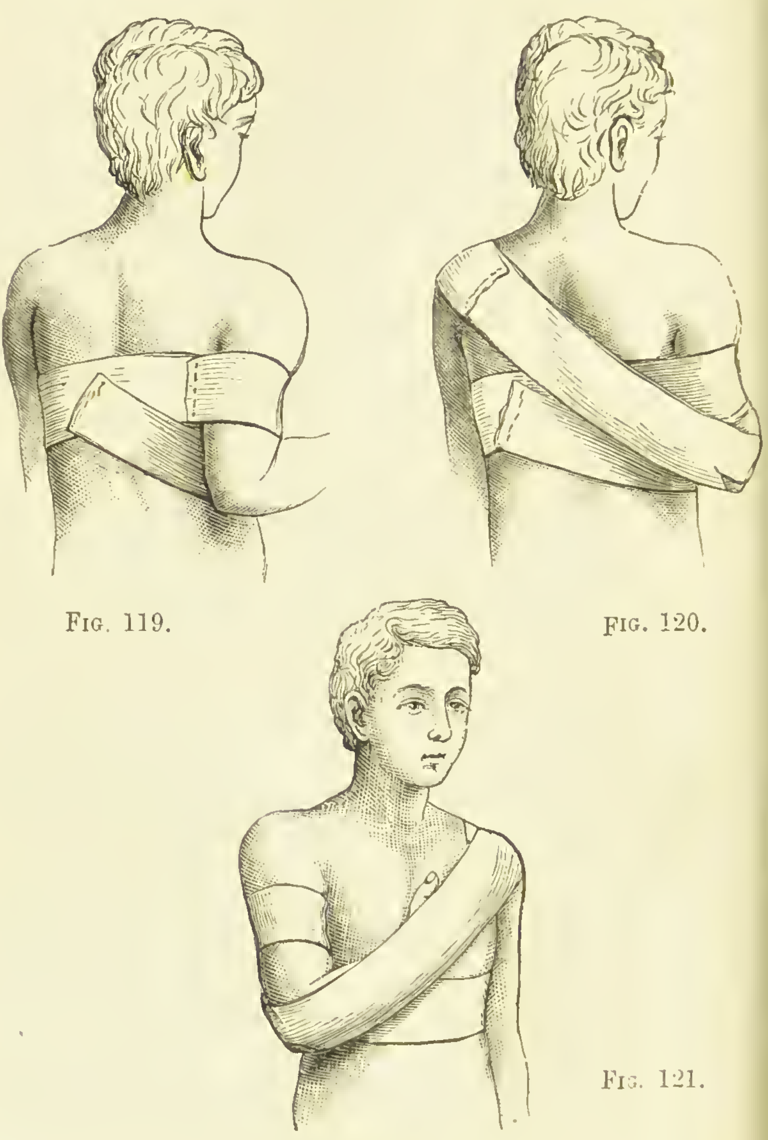


Fig. 119.

Fig. 120.

Fig. 121.

Figs. 119, 120, 121.—Sayre's method of treating fractured clavicle. (After Agnew.)

III. *Fracture of the sternal end* is too rare to require description in a book of this character.

THE SCAPULA.—The fracture may extend through 1, the body; 2, the neck; 3, the acromion; 4, the coracoid process; and 5, the glenoid cavity.

1. *Fracture of the body* is nearly always caused by direct violence. It may be star-shaped or transverse, or it may run vertically or obliquely through the spine; but commonly it is limited to the infraspinous fossa, and frequently the angle is alone broken off. The displacement is not usually very marked, as the fragments are well covered with muscles. *Signs.*—On fixing the angle of the scapula with one hand, and raising the arm, crepitus and pain may be elicited. On running the fingers along the spine and down the posterior border, some irregularity may be detected when these parts are involved, and on grasping the bone the fragments may be felt to move on each other. *Treatment.*—Little can be done beyond confining the scapula by strapping and a bandage to the chest, and restraining the motions of the arm by bandaging it to the side.

2. *Fracture of the neck.*—By this is understood fracture through the surgical neck, *i.e.*, internal to the coracoid, so that the latter process is separated with the glenoid cavity from the rest of the bone. There is a specimen of it in the College of Surgeons' and Guy's Hospital Museum (Fig. 122), though it is stated by some not to occur. The *signs* which have been ascribed to this injury resemble those of dislocation of the humerus downwards. The deformity, however, is said to disappear on pressing up the elbow, when crepitus can be elicited, and to reappear on removing the pressure. The *treatment* recommended is to raise the elbow, and maintain the parts in their restored position by a bandage.

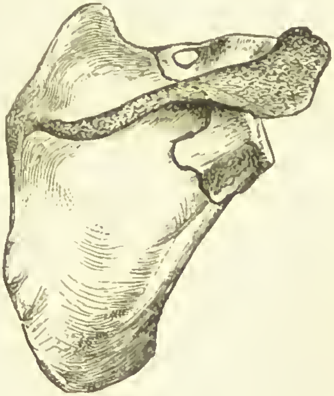


FIG. 122.—Fracture of the neck of the scapula. (Bryant's Surgery.)

3. *Fracture of the acromion* may occur at any situation. *Cause.*—Direct violence, such as a blow or fall on the shoulder. *Nature of the displacement.*—The outer fragment

is drawn downwards by the deltoid, leaving a gap between it and the rest of the bone. *Symptoms.*—Pain, flattening of the shoulder, presence of a gap on drawing the finger along the spine, acromion, and clavicle; and crepitus on raising the arm and thus bringing the fragments into apposition. *Union.*—When near the tip the union is fibrous; when near the base, it is said to be bony. *Treatment.*—Raise the elbow so as to relax the deltoid, and fix the arm to the side by a sling and bandage, protecting the parts by a gutta-percha cap moulded to the shoulder. Some employ an axilla-pad.

4. *Fracture of the coracoid process* may occur either near the tip or the root. The cause is usually direct violence, such as a kick or fall on the shoulder. *Nature of the displacement.*—When the fracture is near the tip the distal fragment is drawn downwards by the biceps; when near the root it is held in position by the coraco-clavicular ligaments, and but little displacement occurs. *Signs.*—Bruising and pain over the situation of the coracoid. On placing the finger on the tip of the coracoid some alteration in its relative position may be made out, and crepitus elicited by moving the arm. *Treatment.*—The forearm should be flexed to relax the biceps; the arm and forearm bandaged to the side; and a cap of gutta-percha placed over the shoulder.

5. *Fracture of the glenoid cavity* is rare. At times it occurs in connection with dislocation of the shoulder.

THE HUMERUS. Fractures of the humerus are divided into fractures of 1, the upper end; 2, the shaft; and 3, the lower end.

1. THE UPPER END OF THE HUMERUS.—*Varieties.*—A. Intracapsular, or fracture of the anatomical neck. B. Extracapsular, or fracture of the surgical neck. C. Separation of the upper epiphysis. D. Fracture of the greater tuberosity.

A. *The intracapsular fracture* may be impacted or non-impacted. When *impacted* the upper fragment, or head, is generally driven into the lower, that is, between the tuberosities. *Cause.*—Generally direct violence, as a blow or fall on the shoulder. *Signs.*—Often obscure. There may be pain, swelling, impaired movement, and crepitus, with absence of signs of dislocation or of other fracture about the shoulder. In the *impacted* variety there is generally some prominence of the acromion; loss of rotundity of the shoulder; slight shortening of the arm; inability to feel the whole of the head in the glenoid cavity; and crepitus on firmly grasping the head and rotating the shaft. *Method of union.*—Fibrous or bony, often with excess of callus and impairment of movement of the joint. *Treatment.*—Apply a leather or poroplastic shield to the shoulder and outer side of the arm, rectifying any displacement inwards by a pad in the axilla. Bandage the arm from the fingers upwards to prevent swelling, and confine it to the side of the chest without raising the elbow. When the fracture is impacted do not disturb the fragments. Passive movements should be begun early (in about three weeks).

B. *The extracapsular fracture* is the most common form of fracture about the shoulder. It may, like the intracapsular variety, be impacted or non-impacted; but when impaction occurs it is the lower fragment that is driven into the upper, *i.e.*, the narrower shaft between the broader tuberosities. *Cause.*—Generally direct violence. *Nature of the displacement.*—The upper fragment is drawn outwards by the three muscles inserted into the greater tuberosity; the lower fragment is drawn upwards by the deltoid and inwards by the three muscles inserted into the bicipital ridges (Fig. 123). *Signs.*—Pain, swelling, and impaired movement; marked shortening of the arm; projection of the rough end of the lower fragment, usually below the coracoid; and increased mobility of the arm to the surgeon. On rotating the arm, the head remains motionless in the glenoid cavity, whilst on extension crepitus is felt. In the *impacted* form the signs are very obscure, and principally negative. Thus, there may be deformity, slight shortening, and impaired movement; but there is no crepitus, unless unjustifiable force is used. *Union* is generally bony. There is often much impairment of movement, in consequence of inflammatory thickening. and sometimes paralysis of the deltoid, from the involve-

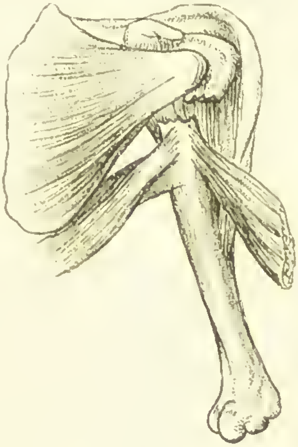


FIG. 123. — Extracapsular fracture of the humerus. (After Gray.)

ment of the circumflex nerve in the callus. *Treatment.*—Similar to the intracapsular form. Place a pad in the axilla, and a poroplastic shield over the shoulder and outer side of the arm. Support the hand in a sling, but do not raise the elbow, in order that the weight of the arm may act as an extending force to overcome the upward displacement.

C. *Fracture through the greater tuberosity* is the result of great violence, and is very rare. *Nature of the displacement.*—The humerus is drawn inwards beneath the coracoid process by the muscles inserted into the bicipital ridges, and the greater tuberosity backwards by the three muscles inserted into it. *Signs.*—The shoulder is greatly increased in breadth; a vertical gap may, perhaps, be made out between the tuberosity and the head of the bone; and on approximating the fragments, crepitus can be felt. *Treatment.*—Endeavour to bring the fragments into contact and to keep them so by an axillary pad, strapping and bandage; apply a shield over the shoulder, and confine the arm to the side.

D. *Separation of the upper epiphysis* can only occur in patients under twenty-one years of age. *Nature of the displacement.*—The upper fragment, which includes the tuberosities, is drawn outwards by the three muscles inserted into the greater tuberosity, and the lower fragment upwards by the deltoid, and inwards by the three muscles inserted into the bicipital ridges. The *signs* are similar to those of the extracapsular fracture, save that the projecting end of the lower fragment is smooth and rounded in place of being rough and uneven, and pseudo-crepitus, instead of bony crepitus, is elicited on extension and rotation of the arm. *Method of union.*—Usually bony, but with much less production of callus, and consequently less impairment of movement than in other fractures of the upper end. *Treatment.*—Like that of fracture of the surgical neck.

2. THE SHAFT OF THE HUMERUS may be fractured in any situation, but more often in its lower than in its upper half. *Causes.*—Direct or indirect violence, rarely muscular action. *Nature of the displacement.*—When the line of fracture is transverse little displacement occurs; but when it is oblique, the fragments have a tendency to glide over one another owing to muscular action, although this is somewhat counteracted by the weight of the arm. When the fracture is above the insertion of the deltoid

the upper fragment is drawn inwards by the muscles inserted into the bicipital ridges; whilst the lower fragment is drawn upwards by the biceps and triceps, and outwards by the deltoid. When below the deltoid, the upper fragment is drawn outwards by that muscle and the lower fragment upwards and inwards by the biceps and triceps. *Signs*, usually obvious, viz., pain, preternatural mobility, and generally deformity and shortening; whilst crepitus is readily obtained. *Method of union.*—Generally bony; but it is one of the most common situations of ununited fracture. *Treatment.*—Place the arm and forearm on an inside rectangular splint with three short splints to the humerus, one in front, one behind, and one on the outer side. Or, apply four short splints to the humerus and support the forearm by a sling, leaving the elbow free, so that the weight of the arm may act as an extending force. The splints should be worn from a month to five or six weeks. The fingers and fore-arm may often with advantage be bandaged to prevent œdema

3. THE LOWER END OF THE HUMERUS. — Fractures in this situation may be divided into (*a*) transverse fracture; (*b*) separation of the epiphysis; (*c*) T-shaped fracture; (*d*) fracture of the condyles. Of these, the transverse when above the condyles, the separation of the epiphysis, and the fracture of the tip of the internal condyle, are *extra-capsular;* the others involve the joint. *Cause.*—All varieties are generally the result of direct violence, such as falls upon the bent elbow.

(*a*) *The transverse fracture* may be above or below the condyles; in the former case it is extra-, in the latter intra-capsular. *Nature of the displacement.* —The lower fragment, together with the bones of the forearm, are drawn backwards and upwards behind the upper fragment by the triceps, whilst the lower end of the upper fragment projects in front of the joint (Fig. 124). *Signs.*—The

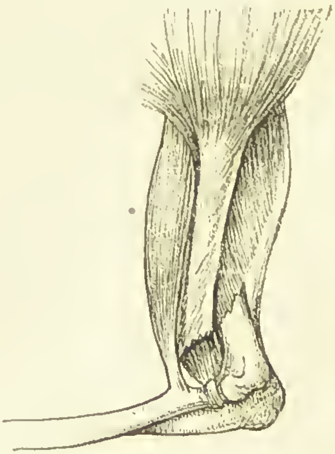


FIG. 124.—Fracture of the lower end of the humerus. (After Gray.)

forearm is shortened and generally bent more or less at a right angle to the arm; the olecranon projects posteriorly; and the lower end of the upper fragment forms a prominence in front of the joint. These signs are similar to those of dislocation of the radius and ulna backwards. The following differences presented by the two deformities should serve to distinguish them; although when not seen immediately after the accident the condition of the parts may be so obscured by swelling that an accurate diagnosis cannot be made till the inflammation has subsided. Thus, in *fracture*—1, the deformity is readily reduced, but reappears on removing the extending force; 2, crepitus is obtained on reduction; 3, the condyles bear normal relations to the olecranon; 4, the distance between the acromion and external condyle is less than on the sound side; 5, the prominent lower end of the upper fragment projects *above* the crease at the front of the elbow. In *dislocation*, on the other hand—1, the deformity does not reappear when reduced; 2, there is no crepitus; 3, the distance between the condyles and olecranon is increased; 4, the distance between the acromion and external condyle is the same on both sides; and, 5, the prominent lower end of the humerus projects *below* the crease at the front of the elbow.

(*b*) *Separation of the epiphysis.*—The signs are similar to the above, but the patient is under twenty-one years of age.

(*c*) *T-shaped fracture.*—In this there is a transverse fracture above the condyles, combined with a vertical or oblique fracture extending between the condyles into the joint. *Signs.*—Similar to the transverse fracture, except that the condyles move on one another as well as on the shaft, and the distance between them is increased. These signs, however, are often obscured by great effusion in and around the joint.

(*d*) *Fracture of the condyles.*—The projecting internal condyle may be broken off without implicating the joint: or the fracture may extend obliquely through either condyle and the contiguous articular surface into the joint. *Cause.*—Generally direct violence. *Signs.*—Mobility and crepitus on grasping the condyles, and on flexing and extending the forearm when the internal condyle is fractured, and on pronating and supinating the hand when the external condyle is fractured.

Method of union.—The extracapsular varieties unite by bone, the intracapsular by fibrous tissue. In the T-shaped fracture the transverse portion unites by bone; the vertical or oblique, *i.e.*, the portion inside the joint, by fibrous tissue.

Treatment.—If there is much swelling, and you cannot be quite sure that there is no dislocation, place the limb on a pillow, or better, on a Stromeyer's cushion, and apply cold in the form of lead lotion or ice, till the swelling has subsided. Subsequently reduce the fracture, and place the arm and forearm on an angular splint or on a bent anterior splint, or in Bavarian plaster, moulded leather, or poroplastic felt splints. Passive movements of the elbow should be begun early. Where the internal condyle only is chipped off, the angular splint should be placed on the outer side of the arm. In the other forms it is usually applied to the inner side.

THE RADIUS AND ULNA. *Cause.*—Generally direct violence, when each bone breaks in the same transverse line at the spot where the force is applied; occasionally indirect violence, as a fall on the hand, when each bone generally breaks at its weakest part—the radius in its upper third, the ulna in its lower third. *Nature of the displacement.*—The upper fragment of the radius is drawn by the pronator teres towards the upper fragment of the ulna, which in consequence of its hinge-shaped articulation with the humerus is not displaced. The lower fragments are drawn towards each other by the pronator quadratus. *Signs.*—Obvious deformity, crepitus, &c. *Treatment.*—Flex the elbow to relax the muscles; reduce the fracture, and place the forearm in well-padded splints with the thumb uppermost. The splints should reach from above the elbow to below the wrist, and should be broader than the forearm so that the bones may not be pressed together by the bandage. If this point is attended to interosseous pads are not necessary. The patient should be seen within twenty-four hours, as swelling may occur and the bandages require loosening. The splints must be worn for about a month, and passive movements of the fingers practised early to prevent stiffening.

Greenstick fracture of the radius and ulna is common in children.

THE RADIUS.—Fractures of the radius may involve, 1, the neck; 2, the shaft; and, 3, the lower end (Colles' fracture).

1. *The neck of the radius* is occasionally fractured. It may be known by crepitus, and by the absence of move-

ment of the head when the hand is pronated and supinated. *Treatment.*—Flex the forearm, and place the limb on an angular splint.

2. *The shaft of the radius* may be fractured by direct or indirect violence. Both fragments are drawn towards the ulna, the upper by the pronator teres, the lower by the pronator quadratus. (Fig. 125.) *Treatment.*—Similar to that of fracture of both bones.

3. *Fracture of the lower end of the radius* (*Colles' fracture*).—The line of fracture generally runs transversely about three quarters of an inch above the articular surface of the bone. *Cause.*—Falls on the palm of the hand. It is more frequent in the old than in the young; and is especially common in elderly women.

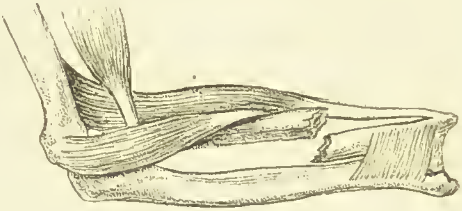


FIG. 125.—Fracture of the radius. (After Gray.)

Nature of the displacement.—Sometimes there may be no displacement, but generally the lower fragment with the hand is so displaced that the articular surface looks downwards, and slightly backwards and outwards, instead of downwards, forwards and inwards. This, according to Mr. R. W. Smith, is due to the action of the supinator longus, the extensors, of the thumb, and the radial extensors of the carpus. By others it is believed to be due to the impaction of the upper fragment into the lower, a condition frequently met with in specimens preserved in museums. Occasionally the lower fragment is displaced forwards in consequence of falls on the back of the hand. Comminution of the lower fragment with involvement of the joint frequently occurs. *Signs.*—Very characteristic. On the back of the wrist, just above the joint, there is a prominence caused by the backwardly displaced lower fragment, and above this a slight depression; whilst on the palmar surface there is a prominence caused by the lower end of the upper fragment, corresponding to the dorsal depression, and below this a depression corresponding to the dorsal prominence. Pronation and supination are lost, the hand is deflected to the radial side, and the lower end of the ulna is prominent. The deformity is well seen in Fig. 126. These signs are similar to those of dislocation of the carpus backwards. The following points will serve to distinguish the two injuries:—In *fracture*, 1, the styloid process of the radius is on a higher plane than that of the ulna; 2, the distance from the internal condyle to the tip of the styloid process of the radius is less than on the sound side; 3, there is crepitus; 4, the deformity, when it can be reduced, has a tendency to return if the extending force is relaxed; and, 5, it is very common in the old, and occurs from slight causes. In *dislocation*, on the other hand, 1, the styloid process of the radius is on a lower plane than that of the ulna; 2, the distance from the internal condyle to the tip of the styloid process of the radius is the same as on the sound side; 3, there is no crepitus; 4, the deformity when reduced has no tendency to return when the extending force is relaxed; and, 5, it is usually the result of great violence, and more frequently occurs in the young than in the old. *Treatment.*—After reducing the fracture as thoroughly

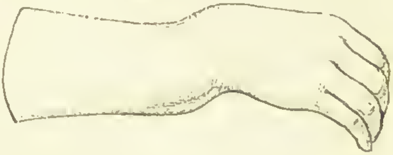


FIG. 126.—Colles' Fracture. (St. Bartholomew's Hospital Museum.)

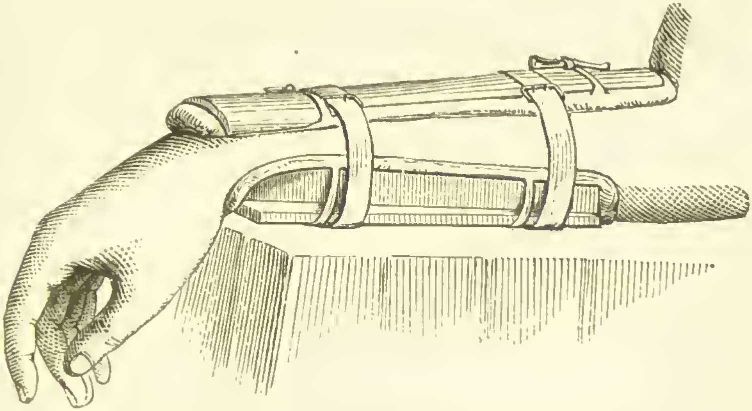


FIG. 127.—Gordon's splint for Colles' fracture. (Gordon's Fractures.)

as possible apply two ordinary forearm splints, taking care that the anterior one does not reach beyond the heads of the metacarpal bones, and place a pad beneath the wrist to restore the lost concavity of the front of the radius. Practise passive movements from the third day, as in this form of fracture the tendons, where they cross the back of the radius, the seat of fracture, are apt to become adherent to their grooves. This is the almost invariable method of treating Colles' fracture at St. Bartholomew's Hospital, and is attended with excellent results. If preferred, Gordon's (Fig. 127), Carr's, Hawkins', or Bond's splints may be used. The pistol-shaped splint introduced by Nélaton, and justly condemned by Sir James Paget as so frequent a cause of stiff wrist and fingers, should on no account be used. Remove the splints in about four weeks' time, and employ shampooing, friction with stimulating liniments, &c., till any stiffness of the joint or fingers that remains has disappeared.

Separation of the lower epiphysis may occur in young subjects and resembles Colles' fracture.

THE ULNA.—Fractures of the ulna may be divided into fracture of—1, the olecranon; 2, the coronoid process: and 3, the shaft.

1. *The olecranon* may be fractured in a transverse or oblique direction. The elbow-joint is always involved, except when the fracture is through the tip of the process only. *Cause.*—Direct violence, as a fall on the point of the elbow, or violent action of the triceps muscle. *Nature of the displacement* (Fig. 128).—The detached fragment is usually widely separated from the rest of the bone by the triceps; but when the periosteum and tendinous ex-

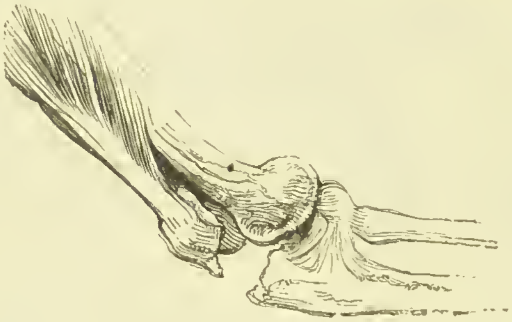


FIG. 128.—Fracture of olecranon. (Liston's Surgery.)

pansion of the triceps covering the olecranon is not torn, and the fracture is very oblique, little or no displacement occurs. *Signs.*—Swelling from effusion of blood, and later of serum, into the joint; inability of the patient as a rule to extend his arm; and generally, the presence of a gap between the fragments.—*Method of union.*—Generally fibrous; but when the separation of the fragments is slight, it may be bony. *Treatment.*—Place the elbow in a position of *slight* flexion on a jointed splint, and apply evaporating lotions till the swelling has subsided. An attempt may be made to bring down the detached fragments by strapping and a bandage. Passive movements should be begun early to prevent ankylosis (seventh day, Hamilton). Many advise that the arm should be put up in full extension; but this is objectionable, as it causes the olecranon to form an angle with the shaft. Mr. Heath on the other hand strongly recommends flexion of the arm to a right angle.

2. *The coronoid process of the ulna*, except in dislocation of the ulna and radius backwards, is rarely fractured. It is said at times to occur from a violent contraction of the brachialis anticus muscle. *Signs.*—Similar to those of a dislocation of the radius and ulna backwards. When fracture of the coronoid is present, the dislocation is readily reduced but immediately returns on relaxing the extending force. When fracture of the coronoid is not present, the dislocation is more difficult to reduce; but when once reduced, has no tendency to recur. *Treatment.*—After reducing the dislocation, place the arm in a flexed position on an inside angular splint. Employ passive movements early.

3. *The shaft of the ulna* is occasionally fractured without implication of the radius. *Cause.*—Direct violence. *Nature of the displacement.*—The upper fragment is not displaced, being held in position by its hinge-shaped articulation with the humerus. The lower fragment is drawn towards the radius by the pronator quadratus. *Signs.*—It is readily detected by running the finger along the prominent posterior border of the bone, when a gap or irregularity is felt, and by crepitus on movement. *Treatment.*—Similar to that of fracture of the radius.

THE CARPUS, METACARPUS AND PHALANGES.—Fractures of these bones require no special mention. They may be diagnosed by the deformity and crepitus. Rest for a few weeks on a splint, followed by passive movements to prevent stiffness, is all that is generally necessary.

INJURIES OF THE LOWER EXTREMITY.

BRUISES or CONTUSIONS, BURNS, SCALDS, and FROST-BITES of the lower extremity call for no special mention beyond that bruises about the hip and ankle may be mistaken for fracture, and that a contusion of the limb may be so severe at times as to terminate in gangrene.

SPRAINS of the ankle and knee are very common. Pain, inability to bear any weight on the limb, effusion into the joint or the sheaths of the surrounding tendons, and later, ecchymosis of the skin, are the usual signs. A sprain of the ankle, when there is much swelling, is often difficult, and sometimes impossible, to diagnose from a fracture, and should then be treated as such. For an ordinary sprain absolute rest should be enjoined, and cold or evaporating lotions or a wet bandage should be applied. When the swelling has subsided, the part may be put in a plaster-of-Paris bandage or in a poroplastic splint for some weeks, and then shampooing and passive movements employed if any stiffness be left.

RUPTURE OF MUSCLES AND TENDONS, either as the result of external violence or of sudden and spasmodic contraction of the muscle, is not infrequent in the lower limbs. Here, only rupture of the plantaris or Achilles tendon requires special notice. It usually happens in men beyond the middle period of life without any evident cause. It is attended with a distinct snap, and a feeling as if the part had been struck, followed by pain, and sometimes by ecchymosis and inability to raise the heel. *Treatment.*—A plaster-of-Paris bandage should be applied with the foot in the extended position to approximate the ends of the ruptured tendon. If a heel is made to the plaster case, the patient need not lay up. The plaster case should be worn for two or three weeks.

Dislocations of the Lower Extremity.

DISLOCATION OF THE HIP.—This injury is much less common than dislocation of the shoulder, a fact readily explained by the strength of the capsular ligament, the depth of the acetabulum, and the powerful muscles by which the joint is surrounded. It occurs, however, more frequently than might be expected, owing to the powerful leverage which, from the great strength of the femur and length of the leg, is brought to bear upon the joint in falls upon the knee and foot with the limb extended and abducted. Dislocation, therefore, as might be inferred, is more common in young and strong adults; fracture of the neck of the femur in the old and feeble. *Cause.*—Dislocation of the hip, whatever form it may take, generally occurs when the limb is abducted. In this position the head of the bone presses upon the inner and lower part of the capsule, its weakest part, and if any sudden or great force is now applied to the other end of the lever, the head of the bone may be forced through the capsule at this spot into the obturator foramen. Here it may remain, or if at the time of the accident the limb is flexed and rotated inwards as well as abducted, it may be carried round the outer margin of the acetabulum on to the dorsum ilii; or if the limb is extended and rotated outwards as well as abducted, round the inner margin on to the pubes. In rare instances, it would appear to occur during forced adduction of the limb, the head of the bone being then driven directly backwards on to the dorsum ilii. In such a case, however, the rim of the acetabulum is generally, though not always, splintered off at the same time.

The Y, *or ilio-femoral ligament* plays so important a part in dislocation of the hip that its attachments should be briefly considered before studying the varieties of this form of dislocation. It consists of a thickening of the front of the capsular ligament, and is attached above to the anterior inferior spine of the ilium, and then divides into two branches like the letter Y inverted. The outer branch is inserted into the upper part of the anterior trochanteric ridge; the inner branch into the lower part of that ridge. It is exceedingly strong, and will bear a breaking strain of from 250 to 750 pounds. Both branches limit extension, the outer branch rotation outwards as well. The whole ligament therefore is tense during extension and rotation of the limb outwards; relaxed during flexion and rotation inwards.

VARIETIES.—Dislocations of the hip are divided by Bigelow into the *regular*, in which one or both branches of the Y ligament are intact, and the *irregular*, in which both branches are ruptured. In the former the signs are constant, as the untorn branch of the Y ligament compels the bone to take a certain definite position. In the irregular the signs vary, as both branches of the Y being ruptured, the control which it exercises over the position of the bone is lost. Our attention here will only be directed to the regular dislocations. Of these Bigelow describes seven, the first four of which are commonly known as the *classical dislocations of Sir Astley Cooper.*

Cooper's Classification.	Bigelow's Classification.	
	A. Regular. One or both branches of Y entire.	
Dislocation on to the dorsum ilii	= 1. Dorsal	Both branches of Y entire.
Dislocation into the sciatic notch	= 2. Dorsal below the tendon	
Dislocation into the obturator foramen	= 3. Thyroid and downwards	
Dislocation on to the pubes	= 4. Pubic and subspinous	
	5. Anterior oblique	
	6. Supraspinous	Outer branch of Y ruptured.
	7. Everted dorsal	
	B. Irregular. Both branches of Y ruptured.	

1. *Dislocation on to the dorsum ilii* (*the dorsal of Bigelow*).—This is the most common form of dislocation of the hip. The head of the bone is thrown upwards and backwards on to the dorsum of the ilium, the articular surface of the head looking backwards, and the great trochanter forwards. The capsular ligament is generally ruptured at its lower and inner part, sometimes posteriorly, and the round ligament is usually torn. The Y ligament is uninjured, the external branch preventing eversion. The glutei muscles are raised from the ilium by the head of the bone, which is always situated above the tendon of the obturator internus. The other external rotators have been found variously lacerated or torn from their attachments. *Signs* (Fig. 129).—The limb is slightly flexed, adducted, rotated inwards, and shortened, so that the lower end of the femur crosses the lower third of the opposite thigh, and the great toe rests on the instep of the opposite foot. The head of the bone, at least in thin subjects, can be felt in its abnormal situation on rotating the

limb. The great trochanter is above a line drawn from the anterior superior iliac spine to the most prominent part of the tuberosity of the ischium (*Nélaton's line*); and the distance from the top of the great trochanter to a line

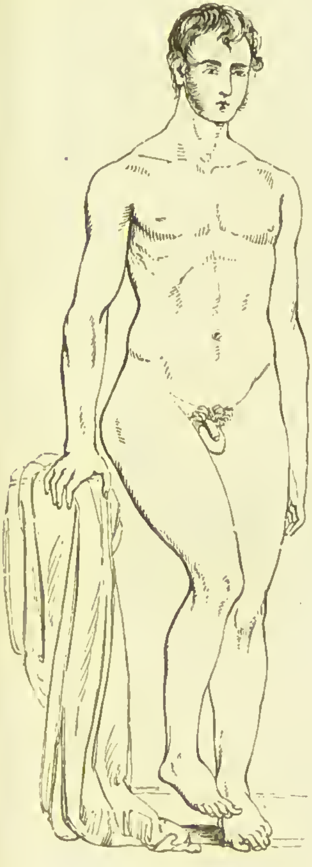


Fig. 129.—Dislocation on dorsum ilii.

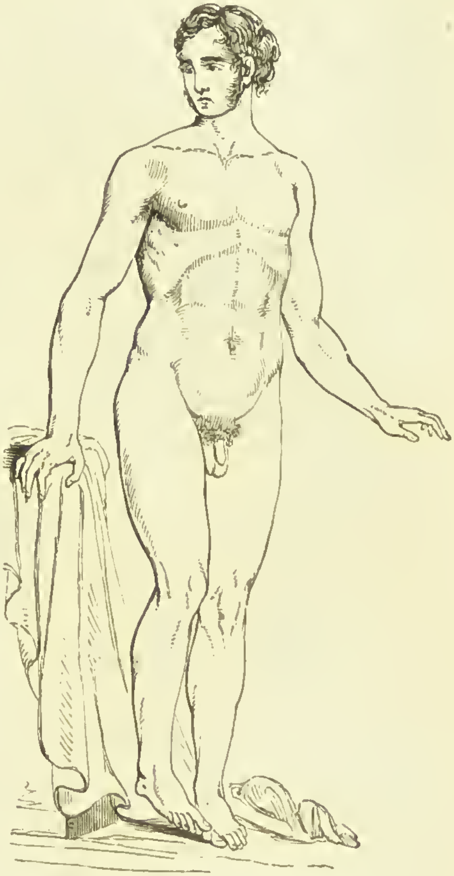


Fig. 130.—Dislocation into sciatic notch.

(Cooper's Dislocations.)

drawn horizontally round the pelvis on a level with the anterior superior iliac spines (*Bryant's line*) is less on the injured than on the sound side.

2. *Dislocation into the sciatic notch* (*the dorsal below the tendon of Bigelow*).—The head of the bone escapes below the tendon of the obturator internus, and then ascends behind it on to the surface of the ilium just in front of

the sciatic notch, or on the pyriformis as it emerges from the notch. The head looks backwards and the great trochanter forwards, eversion being prevented by the outer branch of the Y ligament. The tendon of the obturator internus winds over the neck of the femur, and is therefore the great obstacle to reduction. The capsule is generally torn below, the round ligament ruptured, the gluteus maximus raised by the head of the bone, and one or more of the external rotators are usually torn. The *Signs* (Fig. 130) are very similar to those of the former variety; but the flexion, adduction, and rotation inwards are less pronounced. The lower end of the femur crosses the opposite knee, and the great toe rests on that of the opposite foot. Shortening with the limb extended is much less than in the former variety; but with the limb flexed it is much greater. This is shown in the accompanying diagram (Fig. 131), and depends upon the fact that in the dislocation on to the dorsum ilii the head of the bone in extension lies above the acetabulum, and when flexed at right angles to the body on the same level as the aectabulum; whereas in the sciatic dislocation the head of the bone in extension is almost on the same level as the acetabulum, but when flexed at right angles to the body lies considerably behind the acetabulum.

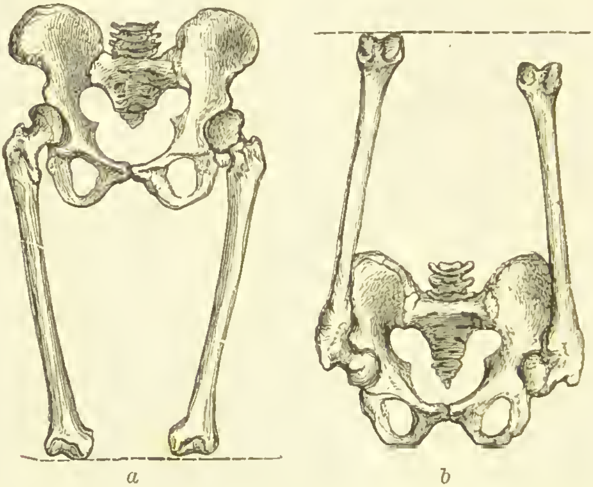


Fig. 131.—Sciatic dislocation. *a*, Shows slight shortening in extended position of limb; *b*, shows marked shortening in flexed position. (After Dawson, of Ohio.)

3. *Dislocation into the obturator foramen* (*the thyroid and downwards of Bigelow*).—The head is displaced downwards on to the obturator externus, where it lies suspended by the Y ligament, and may remain either just below the acetabulum, or be carried slightly inwards towards the perinæum or outwards towards the tuberosity of the ischium. The head of the bone generally looks slightly inwards, and the trochanter outwards. The capsule and round ligament are ruptured, the former at its lower and inner part. The glutei, pyriformis, psoas and iliacus, obturator externus, pectineus, and the adductor brevis are stretched or sometimes torn. *Signs* (Fig. 132).—In the more common form, *viz.*, that in which the head is displaced downwards and a little inwards, the limb is *lengthened*, abducted and slightly flexed, whilst the body is bent forwards to relax the psoas and iliacus, and as there is usually some external rotation, the toes point slightly outwards. The nearer the head of the bone approaches the perinæum the more plainly can it be felt, and the more eversion and abduction will there be; conversely, the nearer it approaches the tuberosity of the ischium the greater its inversion and adduction; whilst when it is displaced directly downwards there will be neither eversion nor inversion, adduction nor abduction, but marked flexion.

4. *Dislocation on to the pubes* (*the pubic and subspinous of Bigelow*).—The head of the bone is thrown forwards and rests below Poupart's ligament, either upon the ramus of the pubes (*pubic*) or upon the pectineal eminence just in front of the anterior inferior spine (*subspinous*). The head looks forwards and the trochanter backwards. The capsule is generally torn below, and the round ligament ruptured. The Y ligament is entire, and produces the eversion of the limb characteristic of this variety. The psoas and iliacus, with the anterior crural nerve between them, are generally stretched tightly over the head of the bone. The femoral vessels are displaced to its inner side. *Signs* (Fig. 133).—The limb is slightly shortened, flexed, abducted, and rotated outwards; and the head of the bone can be plainly felt in its new situation, whilst there is flattening over the hip-joint

The *anterior oblique*, *supraspinous*, and *everted dorsal*, the three remaining regular dislocations of Bigelow, are too rare to be described here. They can readily be produced, however, on the dead body. Thus the ordinary dorsal dislocation can be converted into the *anterior oblique* by carrying the leg across the symphysis, forcibly everting the thigh, and bringing it down across the lower third of the opposite thigh, in which position it becomes firmly locked. If now the thigh is forced into the perpendicular position, the outer branch of the **Y** ligament will be ruptured and the *supraspinous* variety produced. This variety in its turn can be converted into the *everted dorsal* by circumducting the extended limb inwards and then everting it.

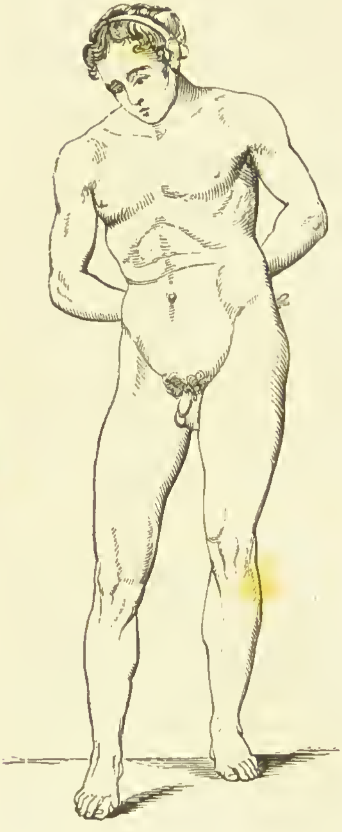


Fig. 132.—Dislocation into obturator foramen.

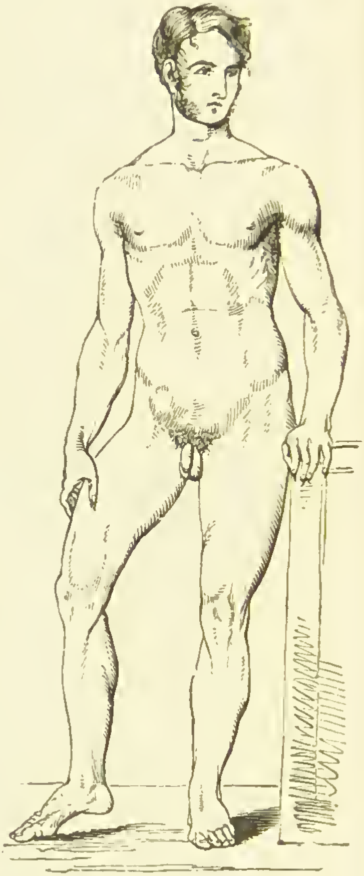


Fig. 133.—Dislocation on the pubes.

(Cooper's Dislocations.)

Treatment.—Reduction may be effected by: 1, manipulation; 2, traction with the limb in the flexed position; 3, traction with the limb in the extended position. Of these methods the first and the second are by far the most scientific, and when their principles are thoroughly understood and they are rightly applied, they are the most successful. Recent dislocations should always be reduced by the first or second method, aided if need be by an anæsthetic; and these methods will also often succeed in reducing cases of long standing after traction in the extended position, even with the pulleys, has failed.

1. *Reduction by manipulation* consists in relaxing the Y ligament, the chief obstacle to reduction, and then by means of various movements of rotation, circumduction and extension applicable to each particular variety of dislocation, in making the head of the bone retrace its steps round the margin of the acetabulum, and finally re-enter the acetabulum through the hole in the capsule by which it escaped. To do this it is necessary to know in what direction the head of the bone looks in any particular position of the limb—a point easily determined

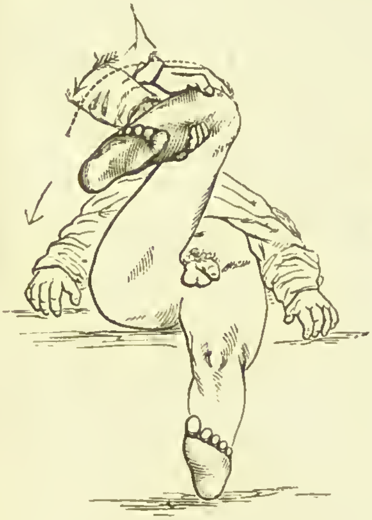


FIG. 134.—Method of reducing the dorsal and sciatic dislocations of the hip by manipulation.

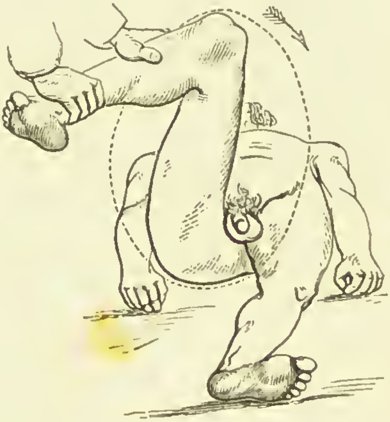


FIG. 135.—Method of reducing the pubic and thyroid dislocations of the hip by manipulation.

(After Bigelow.)

by remembering that the articular surface of the head looks very nearly in the same direction as the internal condyle. It must be further remembered that by rotation is meant the rolling of the femur on its own axis; that in outward rotation the anterior surface of the patella is rolled outwards, and in inward rotation inwards; that by circumduction is meant the revolving of the femur round the axis of its head, and that in this movement the anterior surface of the patella always looks to the front. During the manipulation the patient should be placed upon his back on the floor, while the Surgeon with one hand should grasp the ankle, and with the other the femur or leg, and put the limb through the several movements required for the kind of dislocation. An assistant, if necessary, should fix the pelvis. For the dislocation on the *dorsum ilii* and into the *sciatic notch* the movements are practically the same (Fig. 134). The limb should be flexed and slightly adducted to disengage the head from behind the acetabulum and then abducted, rotated outwards and brought down parallel to the sound limb. These movements are tersely described by Bigelow in the words 'lift up,' 'bend out,' 'roll out.' The head is thus compelled to revolve round a centre formed by the great trochanter, which is held in position by the outer branch of the Y ligament. In the *thyroid* (Fig. 135) the thigh should be flexed and slightly abducted, then rotated forcibly inwards and adducted, and brought down parallel to the sound thigh. The head is thus made to retrace its steps towards, and re-enter the acetabulum, the Y ligament being wound up and so put on the stretch. In the *pubic* the reduction is accomplished in a manner similar to that employed for the thyroid.

2. *Reduction by traction with the limb in the flexed position.*—The flexion of the limb has for its aim the relaxing of the Y ligament and other ligaments and tendons that impede reduction, and then drawing the head of the bone directly into its socket. In the *dorsal* dislocation the thigh should be flexed at a right angle to the body and traction then made in an upward direction, slightly adducting and rotating inwards to disengage the head from behind the acetabulum. Counterpressure may be made, if necessary, by the Surgeon placing his unbooted foot on the anterior iliac spine whilst drawing or jerking the limb upwards. If on flexion it is found that the limb cannot be abducted beyond the perpendicular with the

body, the hole in the capsule is probably too small to allow of the head being replaced. It may readily be enlarged by circumducting the flexed thigh outwards across the abdomen. The pulleys may be used if more force is required, the patient then being laid on his sound side and counter-extension applied to the pelvis by a leather band secured to the wall; or the patient may be placed on his back, the pelvis secured to the floor, and the pulleys attached to a staple in the ceiling. In the *sciatic* the same method should be adopted, as the flexion frees the head of the bone from the tendon of the obturator internus which winds round its neck, and together with

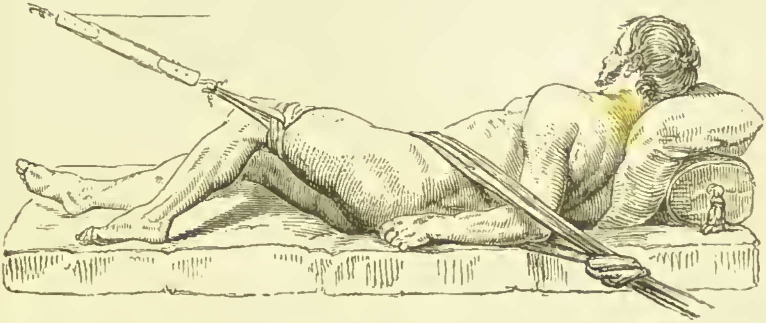


FIG. 136.—Reduction of dorsal dislocation by pulleys in extended position. (Cooper's Dislocations.)

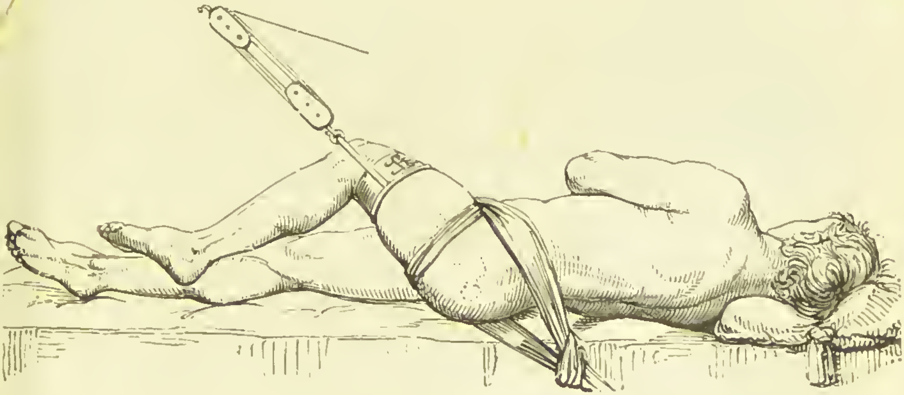


FIG. 137.—Reduction of sciatic dislocation by pulleys in extended position. (Cooper's Dislocations.)

the Y ligament, which is also relaxed by flexion, is the chief obstacle to reduction. In the *thyroid* the limb should be flexed and abducted, and the head of the bone drawn towards the socket, counter-pressure being made, if required, by the unbooted foot on the pelvis. The pulleys may also be employed in this position if more force is required. In the *pubic* the limb should be flexed on the pelvis, whilst the head is drawn down towards the acetabulum and at the same time rotated slightly inwards.

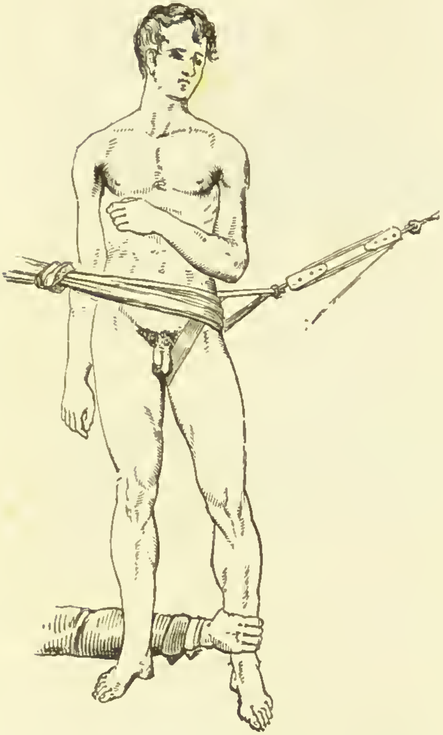


Fig. 138.—Reduction of thyroid dislocation by pulleys. (Cooper's Dislocations.)

3. *Reduction by traction with the limb in the extended position* is the method recommended by Sir Astley Cooper, but is one which is now seldom used except in long-standing cases. It has for its object the drawing of the head of the femur directly into the acetabulum by main force, rupturing any ligaments, muscles, or tendons that offer impediment. The extending force is made in the line of the dislocated femur, generally by means of the pulleys, which are usually secured to the lower third of the thigh by a padded leather band, counter-extension being made simultaneously and in the same straight line as the extension, by fixing the pelvis by means of a perinæal band, secured by suitable straps to a staple in the wall or floor. The patient should be placed on a low couch or on a mattress on the floor. The line of extension and counter-extension differs according to the form of dislocation. Thus:—In the *dorsal* (Fig. 136), extension should be made across the lower third of the sound thigh, the pulleys being fixed to a staple in the

wall a few feet from the foot of the couch above the level of the body, and the counter-extending band to a staple in the floor near the head of the couch. In the *sciatic* (Fig. 137), the extension is made in a nearly similar direction, save that the thigh should be more flexed. In the *thyroid* (Fig. 138), extension is made in an upward and outward direction, by means of a perinæal band passed round the upper part of the dislocated thigh and attached to pulleys fixed to a staple in the wall on the injured side. Counter-extension is made by a band passed round the pelvis and secured to a staple in the floor on the sound side.

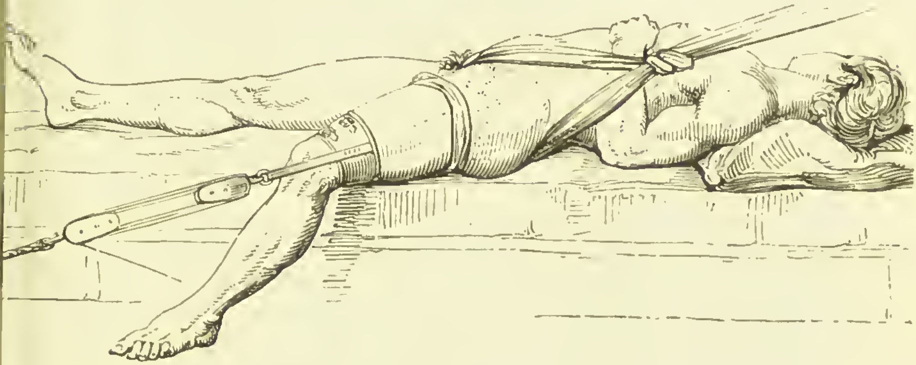


Fig. 139.—Reduction of pubic dislocation by pulleys in extended position. (Cooper's Dislocations.)

The ankle, in the meantime, is drawn towards the mesial line of the body by the Surgeon's hand passed behind the sound limb. The line of extension and counter-extension here runs obliquely across the body. In the *pubic* (Fig.139), extension is made downwards and outwards by pulleys attached to a staple in the floor, counter-extension being made by the perinæal band, which is carried upwards and inwards across the opposite shoulder, and attached to a staple in the wall. After the extension has been applied some time the head of the bone may be lifted over the edge of the acetabulum by a jack-towel, the thigh, if necessary, being rotated inwards at the same time.

The patella may be dislocated outwards, inwards, edgeways, and upwards. The outward variety is the most common; the upward variety can only occur when the ligamentum patellæ has been ruptured or divided. The outward and inward varieties may be complete or incomplete. In the dislocation edgeways, which is very rare, the patella rests vertically on one edge between the condyles, either the outer or the inner edge looking forwards, but most commonly the former. *Cause.*—Muscular action, or a blow on the outer or inner edge of the bone; knock-knee predisposes to the outward dislocation. The *signs* are obvious, the position of the patella indicating the nature of the accident. *Treatment.*—With the patient under chloroform, the thigh should be flexed on the abdomen, to relax the quadriceps extensor muscle; and the leg, for the same purpose, extended on the thigh. In the outward and inward dislocation, pressure should now be made on the edge of the patella that is further from the centre of the joint so as to raise the opposite edge and tilt it over the condyle, when it is at once drawn into place by the action of its muscles. In the edgeways variety, pressure should be made with the thumbs in opposite directions on the upper and lower margin of the dislocated bone, this manipulation being aided by suddenly and forcibly flexing the knee, and then, if necessary, by extending it. Reduction, though generally easy, is sometimes attended with great difficulty, and has occasionally been found impossible, even after subcutaneous division of ligaments and tendons. Effusion into the joint generally follows, and should be treated in the usual way. After reduction the joint should be placed on a back splint or in plaster-of-Paris, and a knee-cap subsequently worn to prevent a recurrence of the dislocation.

THE KNEE.—Dislocation of the knee is exceedingly rare. It may occur in a forward, backward, inward, and outward direction, and in any case may be complete or incomplete. *Cause.*—Usually great violence, as a severe wrench or twist of the joint. *Signs.*—In the lateral dislocations, which are generally incomplete, a projection caused by the condyles of the femur on the one side, with a depression below, and a projection of the tibia, or the fibula, as the case may be, on the opposite side, with a depression above, at once shows the nature of the injury. In the antero-posterior varieties, which are generally complete, there is great shortening and deformity of the limb; the head of the tibia in the forward dislocation projects anteriorly; whilst in the backward it can be felt in the ham. In the former there is generally considerable swelling and congestion, and often pain in the limb below the knee, from pressure of the condyles of the femur on the popliteal vessels and nerves. *Treatment.*—Reduction, as a rule, is easily accomplished by extension, combined with manipulation and pressure in the direction indicated by the variety of the dislocation. The limb should then be placed on a back-splint, and an ice-bag applied to the knee, passive movements being begun at the end of two or three weeks, and a knee-cap subsequently worn for twelve months at the least. Compound dislocations usually, though not invariably, call for amputation.

THE ANKLE.—The astragalus, together with the rest of the bones of the foot, may be dislocated from the socket formed for it by the tibia and fibula, in an *outward*, *inward*, *backward*, *forward*, or *upward* direction. All five varieties are generally complicated by fracture of the fibula, or of the internal malleolus. The *outward* and *inward* varieties will be described under the head of fracture of the fibula (see p. 461). The *backward* and *forward* varieties are rare; the latter especially so. In the former (Fig. 140), the astragalus is either partially or completely driven backwards from its socket, carrying with it, of course, the other bones of the foot; so that the foot appears shortened, the heel prominent, and the tendo Achillis tense. In the *forward* variety the astragalus is generally forced only partially from between the malleoli, and the foot appears lengthened, the heel less prominent than natural, and the tendo Achillis relaxed. In the *upward* variety the tibia and fibula are torn asunder, and the astragalus is forced upwards between them. The ankle appears widened, the malleoli are almost in contact with the ground, and all motion at the ankle-joint is lost. *Treatment.*—The leg having been flexed and the foot extended to relax the calf-muscles, make extension on the foot whilst an assistant holds the thigh, and then manipulate the bones into position. If necessary, give an anæsthetic, and cut the tendo Achillis. Place the foot and leg on a back-splint, or, if preferred, on a Cline's or Dupuytren's splint.

Compound dislocation of the ankle.—In young and healthy subjects an attempt should be made to save the foot, unless the main vessels are torn, or there is much comminution of the bones, or extensive laceration of the soft parts, when amputation is the safer course. Resection of the bones, however, may, in some instances, be undertaken with advantage, but each case must be judged on its merits, and the indications for resection cannot be discussed here.

THE ASTRAGALUS may be dislocated from the tibia and fibula above and from the os calcis and scaphoid below and in front, in a forward, backward, inward, or outward direction; whilst very rarely it may be rotated on its own axis either vertically or horizontally. The forward dislocation, which is generally produced by a wrench of the extended foot, is the most common, the bone in this variety usually inclining either a little outwards, or a little inwards at the same time. The backward dislocation most often occurs from a wrench when the foot is flexed. The lateral dislocations when complete are always compound, and nearly always associated with fracture of the malleoli. *Signs.*—The astragalus in the *forward* variety can be felt projecting under, and often threatening to protrude through the skin of the instep, whilst in the *backward* form it gives rise to a prominence beneath the tendo Achillis, which it causes to bulge backwards, to shortening of the foot, and to a projection of the tibia in front. The *lateral* varieties being compound, the nature of the injury is obvious. *Treatment.*—In the simple form attempts should always be made to push back the displaced bone

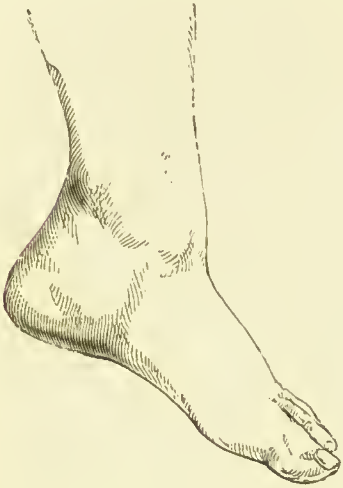


FIG. 140.—Dislocation of the foot backwards. (Bryant's Surgery.)

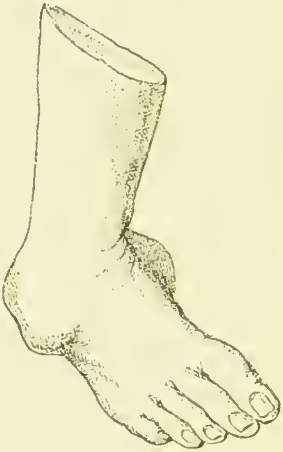


FIG. 141.—Subastragaloid dislocation. (St. Bartholomew's Hospital Museum.)

into its socket, by making pressure in the proper direction, the calf-muscles being relaxed by position, the foot extended, and the tendo Achillis, or any other tendon or ligament that is felt tense, divided if necessary. An anæsthetic is generally required. If reduction is then found impossible, the rule is to leave the displaced bone alone, and only to remove it if sloughing threatens or has actually occurred. In a compound dislocation the bone should, as a rule, be removed at once.

THE SUBASTRAGALOID DISLOCATION is one in which the bones of the foot are displaced from the astragalus, which itself retains its natural connections with the tibia and fibula. The foot is generally displaced either backwards and inwards, or backwards and outwards, more rarely in the opposite directions. In the backward and inward variety (Fig. 141) the foot is inverted, the sole looks inwards, the external malleolus is prominent, the internal malleolus buried by the projection of the os calcis beyond it, and the head of the astragalus forms a distinct prominence on the outer side of the instep, over which prominence the skin is tightly stretched. In the backward and outward variety the foot is everted instead of inverted, the internal malleolus is prominent, the external buried, and the astragalus projects on the inner side of the instep. The forward varieties are too rare to require description. The normal relations of the head of the astragalus, together with the signs above given, will serve to distinguish it from dislocation of the astragalus alone, the injury with which it is most liable to be confounded. *Treatment.*—In the backward varieties the foot should be drawn forwards, whilst the leg is forced backwards, the tendo Achillis and the tibialis anticus and posticus being divided if necessary, and the patient put under an anæsthetic. Reduction is sometimes very difficult or even impossible in consequence of the tibial tendons hooking round the head of the astragalus, or of the mutual interlocking of the bones. After reduction the foot should be placed on a splint, and an ice-bag applied. If sloughing occurs, Pirogoff's or Syme's operation may be performed.

DISLOCATION OF THE SEPARATE BONES OF THE TARSUS, OF THE METATARSAL BONES, AND OF THE PHALANGES OF THE TOES are too rare to require special description.

Fractures of the lower Extremity.

FRACTURES OF THE FEMUR may be divided into fractures of, I. *the upper end;* II. *the shaft;* and III. *the lower end.*

I. FRACTURES OF THE UPPER END OF THE FEMUR may be divided into, 1, intracapsular fracture of the neck; 2, extracapsular fracture of the neck; 3, fracture of the great trochanter; and, 4, separation of the epiphysis of the head.

1. INTRACAPSULAR FRACTURE occurs most frequently in the old, and more commonly in women than in men. *Cause.*—The atrophy and fatty degeneration of the bone, and the diminished obliquity of the neck which is said frequently though not invariably to attend old age, are the chief predisposing causes. Professor Humphry maintains, however, that there is no diminution of obliquity as age advances. Slight indirect violence, such as slipping off the curbstone, catching the toes in the carpet, &c., is the common exciting cause.

State of the parts.—The line of fracture may be situated at any part of the neck within the capsule, and may be transverse or oblique; the usual situation, however, is just external to the head, and the direction transverse. The fragments may be impacted or non-impacted, but impaction is the exception. In the impacted form the lower fragment is nearly always driven into the upper; when, however, the fragments are very jagged, mutual interlocking may occur. The periosteum covering the neck—the cervical reflection as it is sometimes called—may be partially or completely torn, so that all connection between the head and the rest of the bone is severed. Upon the extent of its rupture will in part depend the amount of displacement of the fragments, and the kind of union that will occur. In the non-impacted form the lower fragment with the rest of the femur is drawn slightly upwards by the muscles inserted into the trochanters, and at the same time generally rotated outwards. The outward rotation would appear to depend in part on the direction of the line of fracture, and in part on the weight of the limb, which has a natural tendency to roll outwards. *Method of union.*—In consequence partly of the feeble blood supply of the upper fragment, and partly of the fragments not being in apposition, bony union seldom occurs, the parts becoming bound together by fibrous tissue or remaining ununited. In the latter case the fragments become rounded off and polished, forming a false joint; whilst, owing to the absorption of the lower fragment, great shortening of the neck usually ensues.

Signs.—Slight shortening—about three-quarters of an inch—eversion, inability to raise the limb from the horizontal position, approximation of the great trochanter to the anterior superior spine of the ilium, rotation of the great trochanter through a smaller arc than on the opposite side, and crepitus, are the usual signs. Occasionally there may be no shortening at first, and patients have been known to walk after the injury. In rare instances there has been inversion instead of eversion, a fact not easy of explanation. In the *impacted form* there is no crepitus, the shortening is less, and does not disappear on extension, and the patient may be able to raise the limb from the horizontal position, and perhaps, stand or walk on it. *Diagnosis.*—The age of the patient, the very slight shortening, the absence of bruising about the trochanter, the slightness of the violence occasioning it, and the eversion of the limb are the chief signs which point to intracapsular fracture; but it may have to be diagnosed from the extracapsular form, from dislocation of the hip, from dislocation with fracture of the acetabulum, from chronic osteo-arthritis, and from mere contusion of the hip. In the *extracapsular* form the shortening is greater, the patient usually younger, the occasioning violence direct and more severe, and there is often bruising and ecchymosis of the skin and widening of the trochanter. In *dislocation* there is loss of mobility of the limb, and the head of the bone can be felt in the abnormal position. The only common dislocation with which the ordinary form of fracture could be confounded is the pubic, as in this alone is there any eversion; but here the distinct prominence formed by the head of the bone on the pubes at once serves to distinguish it. In *fracture of the acetabulum with dislocation* there is, in addition to crepitus, the presence of the head of the bone in an abnormal situation, whence it can be drawn on extension of the limb, but returns when the extension is relaxed, crepitus during these movements being felt. *Chronic osteo-arthritis*, in which in consequence of the absorption of the head of the bone there is often shortening and eversion, and in consequence of the movement of the osteophytes upon each other crepitus, may be distinguished from intracapsular fracture, which it may simulate should a patient suffering from it have a fall, by the history of the pain, lameness, and stiffness before the injury. In *contusion* of the hip, though there may be eversion of the limb and loss of power, the trochanter retains its normal relations, and there is no shortening or crepitus. It should be remembered, however, that in old people absorption of the neck of the bone may slowly take place after a contusion, and of this the patient should be warned, as otherwise the Surgeon may be accused of overlooking a fracture.

The treatment should vary according to the age and powers of the patient. Thus in the old and feeble in whom bony union can scarcely be expected, and in whom, moreover, long confinement on the back is liable to produce bed-sores and even fatal hypostatic congestion of the lungs, the limb should be merely placed at rest between sand-bags, and the patient only confined to bed for a few days. He should then be allowed to get about on crutches with the parts secured in some form of stiff bandage or moulded leather case, or on a Thomas's hip-joint splint. In younger and fairly vigorous patients an attempt may be made to obtain bony union either by means of extension with the weight and pulley or by the long splint. Confinement to bed for six to eight weeks is usually necessary, followed for another two or three months by the use of some form of stiff apparatus.

2. EXTRACAPSULAR FRACTURES, though more frequent in the old than in the young, are not, like intracapsular fractures, so essentially an injury of old age. Thus, they are frequently met with between the ages of forty and fifty, whereas intracapsular fractures hardly ever occur in persons under fifty. *Cause.*—Usually direct violence as a fall or a severe blow on the great trochanter. *State of the parts.*—The fracture commonly extends through the base of the neck just outside the capsule, and is nearly always associated with a fracture of the great trochanter. It may be impacted or non-impacted, the former condition, however, being by far the most common. Indeed, it is probable, that nearly all extracapsular fractures are, in the first instance, impacted and accompanied by fracture through the great trochanter, and that they only become non-impacted by the splitting asunder of the trochanters, in consequence of the neck being

driven still further in, wedge-wise, between them; and hence, that non-impaction only occurs as a result of great violence. The line of fracture through the trochanter commonly extends obliquely downwards and backwards, and terminates by passing through the trochanter minor; but it may take various directions, sometimes splitting the trochanter into several pieces. The *method of union* is generally bony, and as the blood supply is very good, there is often an excessive formation of callus. In rare instances no union, or fibrous union, occurs.

The *signs* are similar to those of the intracapsular variety. Thus, there is eversion and shortening of the limb, pain on movement, inability as a rule to raise the limb from the ground, and the top of the trochanter is found to be above Nélaton's line, and the base of Bryant's triangle to be less than on the sound side. But the shortening is greater than in intracapsular fracture; the patient is commonly not so old; the fracture is probably produced by direct violence; the trochanter feels enlarged and thicker than that of the opposite side, from being split by the neck; there is swelling and bruising about the hip; and often much subsequent ecchymosis, since the blood being outside the capsule readily makes its way to the surface. In the *non-impacted* variety where there is much comminution of the trochanter, the shortening is as much as two or three inches, and crepitus will be well marked. In the *impacted*, the shortening is much less, seldom exceeding an inch, and crepitus cannot be elicited, unless the fragments are loosely wedged. In firm impaction, indeed, the patient can often raise the leg, or even walk.

Treatment.—In the non-impacted variety, extension should be applied by means of some variety of Liston's long splint, a stirrup, weight and pulley being substituted, if preferred, for the perinæal band. Firm osseous union will generally be obtained in a month to six weeks. In the impacted, extension had better not be made, but the limb merely kept at rest by the long splint till the swelling and pain have subsided, and the patient then allowed to get about on crutches. Firm union will occur, but there will be permanent shortening, and probably some eversion and stiffness of the joint.

3. FRACTURE OF THE GREAT TROCHANTER; and 4, SEPARATION OF THE EPIPHYSIS OF THE HEAD, are too rare to call for description here.

II. Fractures of the shaft of the femur are very common in children, less common in adults, and rare in old people, in whom intra- and extracapsular fractures more readily occur. *Cause.*—Generally the result of indirect violence, occasionally of direct, and rarely of muscular action. *State of the parts.*—The line of fracture is usually transverse or oblique; but in rare instances, almost longitudinal or spiral. The oblique is more common in adults; the transverse in children. The fragments for the most part considerably overlap, producing much shortening. The usual situation of the fracture is about the middle of the bone, though it may occur through the upper or middle or lower third. In the *upper third* (Fig. 142), the lower end of the upper fragment is drawn forwards by the psoas and iliacus, and at the same time, generally abducted and rotated outwards by the glutei and external rotator muscles. The upper end of the lower fragment is drawn inwards by the adductors, and upwards by the quadriceps and hamstrings, whilst it is also rotated outwards in part by the adductors, and in part by the weight of the limb. Occasionally, the upper frag-

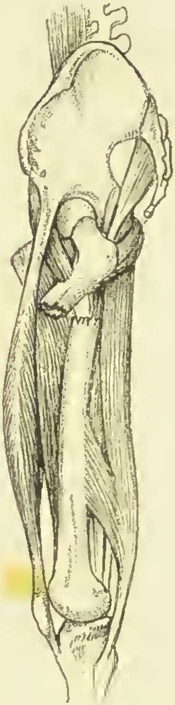


Fig. 142.—Fracture of upper third of femur. (After Gray.)

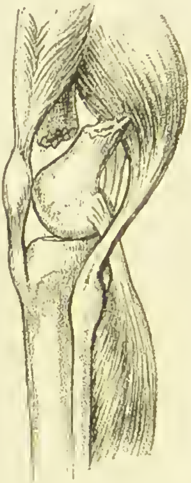


Fig. 143.—Fracture of lower third of femur. (After Gray.

ment is drawn inwards instead of outwards. Union is apt to occur with some overlapping of the fragments and angular deformity. In the *middle third* the displacement is similar, the upper fragment usually projecting in front and to the outer side of the lower. In the *lower third* the upper fragment, in addition to being displaced forwards, is generally drawn towards the middle line by the adductors; whilst the lower fragment, especially when the fracture is just above the condyles, is tilted backwards into the popliteal space by the gastrocnemius where it can be felt as a distinct prominence, and at the same time is drawn upwards by the hamstrings and quadriceps (Fig. 143).

Signs.—In the adult the signs are usually very obvious. They consist in shortening, crepitus, eversion of the foot, swelling from the approximation of the attachments of the muscles, and in preternatural mobility and loss of power in the limb. The ends of the fragments, moreover, can often be felt on manipulation. In young children the diagnosis is not always so easy, especially when the fracture is incomplete; the bowing of the limb, shortening, sensation of yielding or creaking, and the history of the accident, however, will usually prevent a mistake.

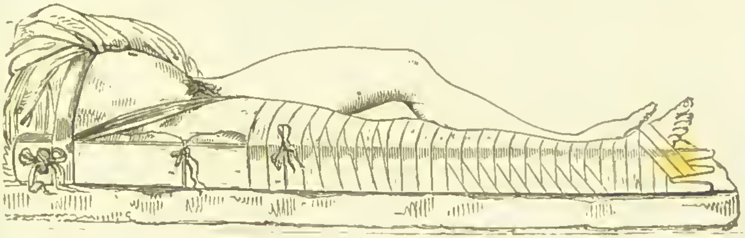


FIG. 144.—Liston's long splint. (Heath's Minor Surgery.)

Treatment.—The methods of treating fractures of the shaft of the femur are very numerous, and may be briefly considered under the following heads:—1, the long splint; 2, the weight and pulley; 3, the double-inclined plane; 4, the plaster-of-Paris or starch bandage.

1. *The long splint* (Fig. 144) in its simplest form consists of a straight lath with two notches at its lower, and two holes in its upper end, and is known as Liston's. It should reach from the axilla to six inches below the

foot. The splint is first bound to the foot and leg by a bandage carried through the notches in the splint, and over the ankle in the form of a figure of 8, and then up the leg, and beyond the knee to prevent relaxation of the ligaments of the joint (Fig. 144). A perinæal band having been previously passed round the perinæum, and its ends brought out through the holes in the top of the splint, is now tightened, whilst extension is made upon the foot, and its ends, as soon as the fracture is reduced, are securely tied. In this way the displacement is prevented from returning. A broad band is finally passed round the thorax to confine the splint to the side. The perinæal band may consist of any soft material, as a folded silk handkerchief, or "piece of bandage sewn in the form of a long bag and stuffed with cotton-wool," with tapes attached at each end. The splint is improved by a cross-bar at its lower end, to prevent the limb rolling outwards, and an oval aperture opposite the external malleolus, to prevent pressure on that bone. As the perinæal band is apt to chafe, some surgeons, in its place, employ, in combination with the long splint, the stirrup, weight and pulley for the purpose of extension, raising the bed at the foot so that the weight of the body may act as the counter-extending force. Many modifications of the long splint are in use; amongst these may be mentioned Boyer's, Desault's, Bryant's, and De Morgan's splints. Bryant's (Fig. 145) consists of two long splints united above and below in the way shown in the drawing, and interrupted opposite the trochanter to avoid pressure on these parts. By its use both limbs are kept parallel, and abduction or adduction of the fractured limb is prevented, whilst extension is kept up by means of the elastic apparatus attached to the side of the splint and connected to the foot-piece

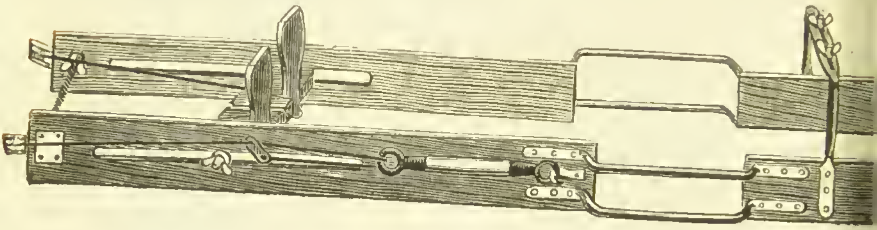


FIG. 145.—Bryant's splint.

by cords and pulleys. If the foot of the bed is raised no perinæal band is required.

2. *The weight and pulley* is frequently used, either alone, or as an addition to the long splint. A long piece of strapping is secured on each side of the leg and lower third of the thigh by strapping and a bandage, leaving a loop about eight inches long under the foot. In the loop thus left a flat piece of wood, about two inches square, is placed, and through a hole in the centre of this a cord is passed and secured by a knot at its end. The cord is then carried over a pulley at the foot of the bed, and a weight of several pounds suspended on it. Counter-extension is made by the weight of the body, the foot of the bed being raised six inches or so on blocks. But the many details involved in its application will be better learnt by three months dressing in the wards than by any verbal description. In children, the limb may be suspended by means of this stirrup in a vertical position to the ceiling (Fig. 146), the weight of the body being the counter-extending force.

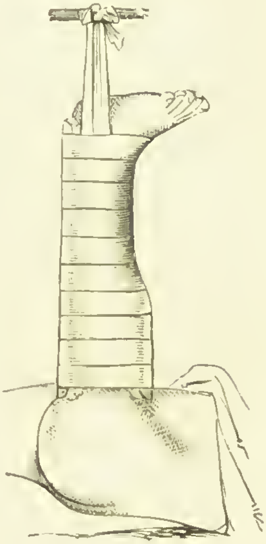


FIG. 146.—Fracture of the femur treated by vertical extension. (Bryant's Surgery.)

3. *The double-inclined plane* is very useful in the treatment of fractures of the upper third of the femur, in which the upper fragment is tilted upwards by the psoas and iliacus, and cannot be kept in apposition with the lower. By means of the double-inclined plane the lower fragment is raised and brought into line with the upper; extension being secured by the leg and foot hanging unsupported down the further side of the plane, and counter-extension by the weight of the body. The plane may consist of an ordinary MacIntyre's splint bent to the proper angle, or of a wooden frame that can be adjusted to the proper height at the apex where the planes meet. Dr. Hodgen's and Dr. Nathan Smith's splints are slinging double-inclined planes, but space does not permit of them being described here.

4. *Plaster-of-Paris and starch bandages* are employed at

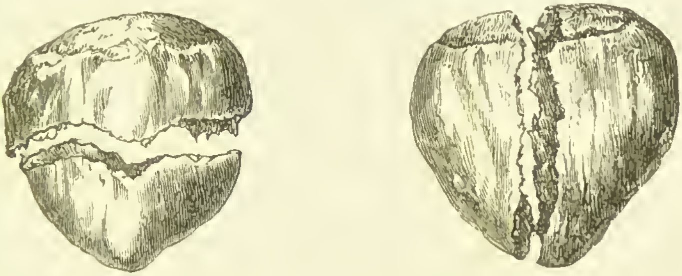
some hospitals from the first, and the patient allowed to get about on crutches.

III. FRACTURES THROUGH THE LOWER END OF THE FEMUR very frequently extend either transversely or obliquely across the shaft, just above the articular surface, and vertically or obliquely between the condyles into the knee-joint, the broken end of the shaft being often impacted between the partially separated condyles. Sometimes the line of fracture may be entirely supra-condyloid, the knee-joint then escaping. In young subjects the fracture may occur in the epiphysial line, with or without splintering of the condyles. Destructive inflammation of the knee-joint is liable to follow fractures through the condyles, but is certainly far from common.

The *signs*, when the fracture is *supra-condyloid*, are similar to those of fracture of the lower third of the shaft. In the T-*shaped fracture* in which the knee is involved, there is usually great swelling of the joint from effusion of blood and serum; increased width of the femur if the condyles are separated from each other; shortening and inability to stand on or use the limb; and crepitus on manipulation, on grasping the condyles, and often on moving the patella laterally. In *fracture through the epiphysis*, the age of the patient, and the soft crepitus characteristic of epiphysial fractures, will point to the nature of the injury. The separation of the fragments, moreover, is usually less than in other fractures in this situation, as the two surfaces are broad. Union generally occurs by bone, and hence shortening is common.

Treatment.—Some form of the long splint may be applied; or extension made by the stirrup, weight, and pulley; or the limb may be placed on a back iron splint, with two side splints, and slung in the way to be described under fracture of the bones of the leg. In the supra-condyloid fracture, where the lower fragment is much tilted backwards by the gastrocnemius, the tendo Achillis may be divided, or the double-inclined plane used. In any case an ice-bag or lead lotion should be applied to the knee till the effusion is absorbed. Passive movements should be begun at the end of about four weeks.

THE PATELLA.—Fractures of the patella are most common in middle life, of more frequent occurrence in men than in women, and very rare in childhood. *Cause.*—They are generally due to a sudden and violent action of the quadriceps extensor muscle, such as is exerted by a person to regain the upright position when he feels himself slipping backwards, the knee being then semi-flexed, and the patella unsupported. It is sometimes caused by direct violence, as a blow or fall upon the knee. *State of the parts.*—When due to muscular action the line of the fracture is transverse (Fig. 147), the aponeurotic covering is usually torn, and the upper fragment generally drawn some distance from the lower by the action of the quadriceps extensor. When due to direct violence it is more often starred or vertical (Fig. 148), and the aponeurosis being intact, there is little or no separation. In any case the fracture, of course, extends into the joint. *Method of union.*—When the fracture is transverse, union is generally fibrous or membranous, rarely osseous, in consequence of the fragments being separated, probably in part by muscular contraction, and in part by the effusion of blood, and later of serous fluid into the joint. In the vertical and starred fractures, where the parts are held together by the untorn aponeurosis, union is usually osseous. *Signs.*—At first a gap between the fragments can be seen and felt, but is subsequently obscured by swelling of the joint. The patient cannot stand, or extend the knee. In a vertical fracture crepitus can usually be detected, and the fragments are not separated.



FIGS. 147 and 148.—Transverse and vertical fracture of the patella.

Treatment.—If seen before effusion has occurred, the whole limb from the ankle to the hip should be enclosed in a Bavarian plaster-of-Paris splint, and the patient confined to bed for a week, and then allowed to get about on crutches. Even when effusion has set in, this plan may be attended with the best results. Usually, however, the limb is placed on a back splint, ice or cold lotion applied till the swelling has subsided, and then an endeavour made to draw down the upper fragment as nearly as may be into contact with the lower. Various forms of apparatus are employed for this purpose, amongst which may be mentioned Manning's, Hamilton's and Steavenson's splints and Malgaigne's hooks (Fig. 149). But plaster-of-Paris applied in the way above described, after the fragments have been as much as possible approximated by strips of strapping, is one of the best methods that can be adopted. On the removal of whatever apparatus is used at the end of six weeks or two months, a leathern knee-cap, to prevent flexion, must be worn from three to six months, and subsequently an apparatus to partially limit flexion for two or three years, as otherwise there is a great tendency for the fibrous material uniting the fragments to become stretched, and the fragments to become widely separated.

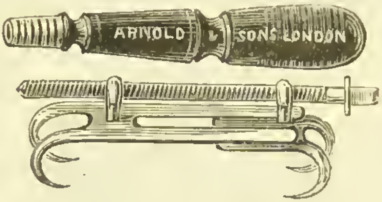


Fig. 149.—Malgaigne's hooks, with key.

Manning's splint.—A piece of webbing is taken the length of the leg, and is first secured to the back of the thigh by a dozen or so strips of strapping, which have been previously sewn to the webbing, the lowest strip being an inch or two from the patella. The whole limb is then placed on a back splint with a foot-piece, the leg and foot being firmly bandaged to it below, and the thigh lightly to it above. The free end of the webbing band having first been brought out through the slit in the splint midway

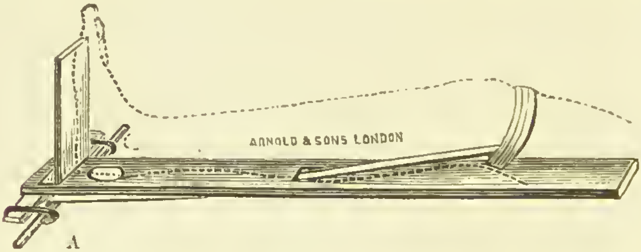


Fig. 150.—Manning's patella splint. The leg is drawn in outline, so as to show beneath it the webbing band passing through the slit in the splint. The strips of strapping should reach up the thigh to the gluteal fold.

between the knee and the ankle (see Fig. 150), is now drawn down towards the foot outside the splint, and having been sewn over a piece of stick is secured to the foot-piece by an india-rubber ring (A) on each side. Thus elastic tension is continually exerted upon the upper fragment, so drawing it down towards the lower.

Aspiration of the joint. Wiring of the fragments.—With the object of obtaining firm fibrous or bony union, some Surgeons, where there is much distension of the joint, draw off the blood or serum with the aspirator; and others lay the joint freely open and wire the fragments of the patella together. The latter proceeding, it cannot be denied, has often secured bony union without any ill effects, but on the other hand, suppuration, stiff-joint, amputation, and even loss of life have resulted. In the face of these facts, therefore, and considering that no such dangers attend the ordinary methods, and that by these methods a perfectly useful joint can be obtained, even though the union is only fibrous, I, for my own part, have always hesitated to undertake such an operation for a recent fracture of the patella.

THE TIBIA AND FIBULA.—Both bones, or the tibia or fibula alone, may be fractured.

Fracture of both bones, which is by far the most common variety, may be due to either direct or indirect violence. When the result of direct violence, the fracture occurs at the spot where the force is applied, and both bones are usually fractured more or less transversely, and in the same line; but when the result of indirect violence, the tibia generally first gives way at its weakest spot, *i.e.*, about the junction of the middle with the lower third, and then the fibula also at its weakest spot, *i.e.*, in its upper third, and the fractures are usually oblique. In the transverse fracture but little displacement occurs; in the oblique, in which the line of fracture usually runs downwards, forwards, and a little inwards, the lower fragments are drawn upwards, backwards and outwards, behind the upper, by the muscles of the calf, while the sharp end of the upper fragment of the tibia projects forwards, threatening, and indeed often causing, perforation of the skin (Fig. 151).

Fracture of the tibia alone is generally *caused* by direct violence, as a kick or a blow on the shin, occasionally by indirect violence, as a fall on the foot. *Nature of the displacement.*—The fracture is usually situated in the lower third of the bone, and is generally transverse, and attended by little displacement, the fragments being held in position by the fibula, which plays the part of a splint. Fractures of the upper and lower ends, involving the knee- and ankle-joints respectively, and separation of the upper and lower epiphysis, may also occur, but are rare.

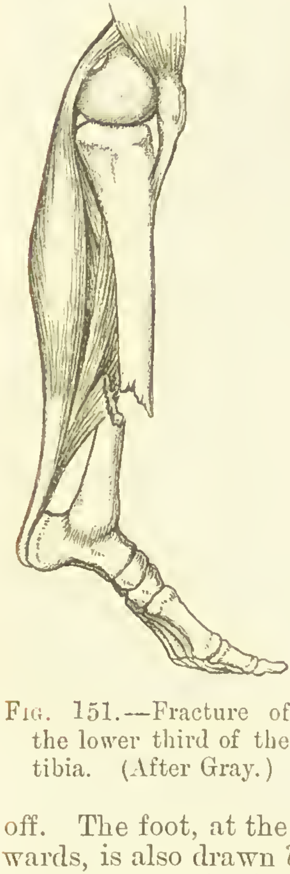


FIG. 151.—Fracture of the lower third of the tibia. (After Gray.)

Fracture of the fibula alone is more common than fracture of the tibia alone. *Cause.*—Though sometimes produced by direct it is more often the result of indirect violence, such as a severe wrench or twist of the foot. The fracture is then generally situated from two to three inches from the external malleolus, and the foot is at the same time very commonly dislocated either outwards or inwards, according to the direction of the force. *Nature of the displacement.*—In the fracture with outward dislocation of the foot (*Pott's fracture*, as it is generally called), the upper end of the lower fragment is driven inwards towards the tibia, the external lateral ligament remains intact, but the internal lateral ligament is ruptured, or the end of the internal malleolus is torn off. The foot, at the same time that it is displaced outwards, is also drawn *backwards* by the tendo Achillis. In the fracture with inward dislocation (which is rare), the articular surface of the external malleolus usually follows the astragalus, and the upper end of the lower fragment of the fibula in consequence projects outwards.

Signs.—In fracture of both bones the signs are usually unmistakable, especially when the fracture is oblique and in the lower third of the leg. When the tibia or fibula alone is fractured the diagnosis is often very difficult. In the tibia, some irregularity may be felt on running the finger along the shin, and crepitus may perhaps be elicited. In the fibula, fracture of the lower third may be detected by running the finger along the subcutaneous surface of the bone just above the external malleolus; but if the case is not seen till swelling from effusion has set in, it may be quite impossible to say whether we are dealing with a fracture or a sprain. If in doubt the case should be treated as a fracture. In the upper two-thirds, where the bone is covered with muscles, and cannot be felt, the following tests for fracture may be applied. 1. Move the foot laterally, and crepitus will probably be elicited if there is a fracture. 2. Press the tibia and fibula together just above the ankle by grasping them with the hand. In fracture, pain will be felt at the fractured spot, not at the situation where grasped. 3. Grasp the tibia and fibula with the hands just below the knee and above the ankle. If there is a fracture the natural springiness of the fibula will be lost, and crepitus may perhaps be detected. In *Pott's fracture* (Fig. 152), the foot is twisted outwards, so that whilst the inner edge is towards the ground the sole is directed outwards. There is a well-marked depression over the seat of fracture, the internal malleolus projects prominently under the skin, and crepitus can be easily obtained. There is also marked *backward* displacement of the foot.

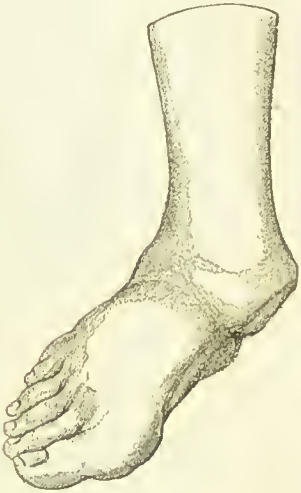


Fig. 152. — Pott's fracture. (St. Bartholomew's Hospital Museum.)

Treatment.—In uncomplicated fractures of the tibia or fibula alone, the leg may be placed at once in plaster-of-Paris splints, and the patient, after a few days' rest in bed, allowed to get about on crutches. Where there is much swelling, the leg had better be placed for a few days on a back-splint to allow the swelling to subside before the plaster-of-Paris is applied. In simple fracture of both bones, where the line of fracture is transverse and there is but little swelling or displacement, the same treatment may often be adopted with advantage. But greater care and watchfulness will be necessary to prevent any untoward accident. Indeed, whenever this method of treating fractures is used, the precautions mentioned at page 164, should be taken. When there is any displacement, however, the fracture must be reduced by making traction upon the foot whilst the thigh is steadied by an assistant, taking special care to correct the eversion, so frequently present, of the lower fragment. You will know when this has been done by the inner side of the patella, the internal malleolus, and the inner side of the great toe being in the same line. Further, you should not, as a rule, rest satisfied as long as any irregularity can be felt on drawing your finger down the crest of the tibia, or as long as any marked difference is apparent on comparing the fractured with the sound leg. If any difficulty is

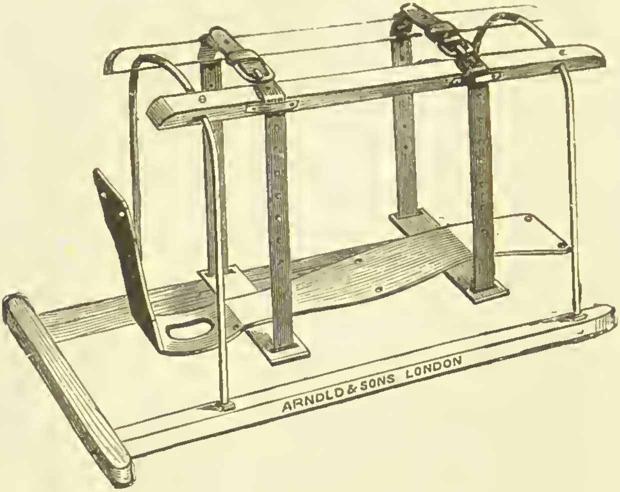


FIG. 153.—Fracture apparatus for the bones of leg.

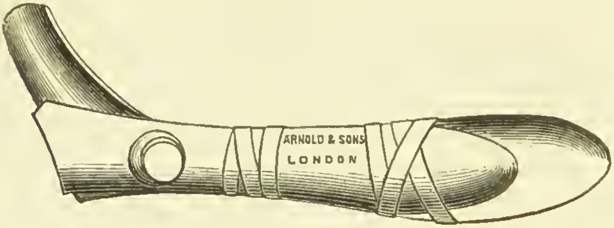


FIG. 154.—Cline's splints for Pott's fracture. The outside splint is known by the foot-piece.

experienced, give chloroform, and if necessary, cut the tendo Achillis. Having reduced the fracture, secure the foot and leg on a splint. Whatever form of the various splints for the purpose is adopted, take care:—1, that the foot is at right angles to the leg; 2, that the ball of the toes and the heel touch the foot-piece of the splint; 3, that the foot is square with the foot-piece; and 4, that the back of the heel is kept from contact with the splint by a small pad placed under the tendo Achillis just above the heel. The iron splint and cradle, shown in Fig 153, is almost invariably employed by the whole of the surgical staff at St. Bartholomew's Hospital for ordinary fractures of the tibia and fibula and with the most satisfactory results. In applying the splint, which should reach as high as the junction of the middle with the lower third of the thigh and should be well padded and shaped to the limb, the foot is first secured to the foot-piece by strapping and a bandage. The Surgeon having then assured himself that the fracture is in good position, secures the splint by a broad strip of strapping, and a figure-of-eight bandage over the knee. The splint is next swung in the cradle, as shown in the figure, and side splints are then applied and secured by webbing straps. In the case of fracture of both bones, the apparatus is generally kept on for a month; in the case of the fibula or tibia alone, for two to three weeks. The leg is then placed in a plaster-of-Paris, a gum and chalk, or a silicate of soda bandage. In *Pott's fracture*, the above apparatus is also generally used, and here again I speak of it in the highest praise. Where, however, there is much difficulty in keeping the bones in good position, the leg is laid on its outer side, with the knee semi-flexed to relax the gastrocnemius, and secured in Cline's splints (Fig. 154), the tendo Achillis being divided, if found necessary.

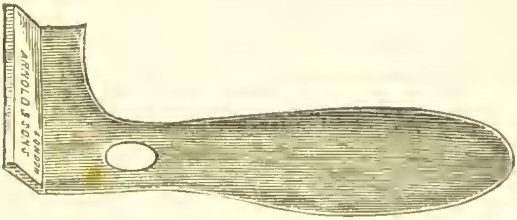


FIG. 155.—Roughton's splint.

The backward displacement of the heel, however, is best corrected by using Roughton's modification of this splint (Fig. 155). It consists of an outside splint with a foot-piece. The heel is drawn forward and secured in position by a 'heel bandage,' the limb being fixed to the splint by two other bandages, one placed just above the ankle and the other just below the knee (Fig. 156).

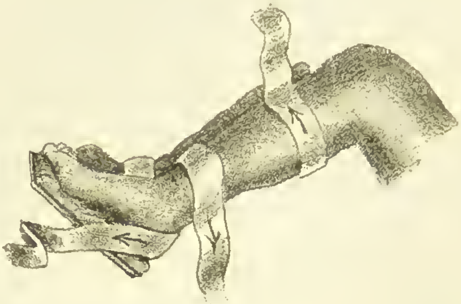


Fig. 156.—Roughton's splint applied. The arrows show the direction in which the bandages pull.

At times Dupuytren's splint (Fig. 157) may be better adapted to a particular case. This splint consists of a straight splint notched at its lower end. It is placed on the inner side of the limb, and should reach from the tuberosity of the tibia to three or four inches below the foot. A wedge-shaped pad, with its base below, and not extending beyond the internal malleolus, should line the splint. The splint is bandaged on from above downwards, and the leg having been thus secured, the foot is then brought over to the splint by making figure-of-8 turns over the ankle and foot and through the notches at the lower end of the splint. The bandage should not pass over the external malleolus or the seat of fracture. The great objection to the use of this splint is, that having no foot-piece, the foot is not kept at a right angle to the leg.

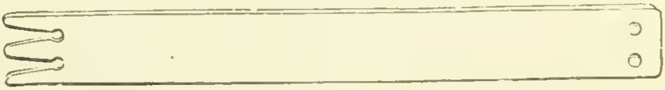


Fig. 157.—Dupuytren's splint for Pott's fracture.

THE TARSUS.—Fractures of the bones of the tarsus are for the most part the result of great violence, and are rare. The only one calling for passing notice is *fracture of the os calcis*, which may occur from a fall on the heel, passage of a wheel over the foot, or violent contraction of the calf-muscles. Crepitus, and, when the line of fracture is behind the interosseous ligament, some drawing up of the posterior fragment by the tendo Achillis, are the chief signs. But where there is much swelling and bruising of the soft parts, the fracture, as is the case in fractures of the astragalus and of the other tarsal bones, may be very difficult to diagnose. Rest, with the foot and leg on a splint, in such a position as to relax the calf-muscles where there is much displacement, and an ice-bag to subdue inflammation, are the points to be attended to with regard to treatment. When the case is seen early, and there is but little swelling, a plaster-of-Paris splint or bandage may be advantageously used.

THE METATARSAL BONES AND PHALANGES of the toes may be fractured by direct violence. No special description, however, of these fractures is necessary.

SECTION VI.

Diseases of Regions.

DISEASES OF THE SCALP AND SKULL.

Erysipelas of the scalp is very common, and may occur idiopathically, or as the result of a wound. In the so-called idiopathic cases, however, it is probable that there is generally some scratch or abrasion through which the specific micrococcus gains admission. The inflammation spreads with great rapidity, but is accompanied by very little redness and swelling, on account of the tenseness of the parts. It is apt to be attended with headache, drowsiness, or delirium, consequent upon the hyperæmia extending to the pia mater. *See* Erysipelas, p. 136.

Cellulitis of the scalp is usually due to a wound, and is described under Injuries of the Scalp. (*See also* Cellulitis.)

Abscess may occur above the aponeurosis, between the aponeurosis and the pericranium, or beneath the pericranium. It is generally the result of an injury, but may be due to the breaking down of gummata, disease of the bones, &c. It is further referred to under Injuries of the Head.

Rodent ulcer, and epithelioma of the scalp, require no special mention.

Sebaceous cysts are very common on the scalp, where they are at times hereditary. They are frequently multiple, and as they increase in size, the hair covering them falls off, and they appear as bare, rounded tumours. The signs, secondary changes, diagnosis, and treatment of these cysts have been given at p. 86. All that need here be repeated is that the mass of granulations which sometimes protrudes from the walls of these cysts (*fungating ulcer of the scalp*) closely resembles epithelioma, from which, however, it may generally be distinguished by the absence of induration and glandular enlargement, and by the history of a sebaceous cyst having been previously present. Congenital or dermoid cysts are described at p. 89.

NÆVI are also common on the scalp. When large, and situated over the anterior fontanelle, they should be dealt with cautiously, lest the membranes of the brain be injured, and meningitis result.

CARIES AND NECROSIS of the bones of the cranium are not uncommon. They are generally the result of syphilitic periostitis, or injury, or very rarely of tubercle, struma or fevers. The external table is the most often affected, but whether the external or the internal table is involved, the disease seldom extends beyond the diploë, as the two tables have a distinct blood-supply. At times, however, complete perforation of the skull occurs. Caries and necrosis in this situation are apt to be followed by septic or infective inflammation of the diploë, and its consequences; by suppuration between the bone and dura mater; by meningitis and abscess of the brain; or by thickening of the dura mater, resulting in persistent headache, or even epilepsy. When the skull is completely perforated, the hole is not filled up by bone; and when necrosis occurs the sequestrum is not invaginated. *Treatment.*—Beyond keeping the parts aseptic, providing free exit for the discharges, and removing loose sequestra, little, as a rule, is required. Should pus collect between the bone and dura mater, it must be let out by the trephine; and a portion of necrosed inner table may also require the trephine for its removal. Appropriate constitutional remedies for syphilis or struma will of course also be necessary.

EXOSTOSES of the skull are described under Diseases of Bone, p. 225.

MENINGOCELE AND ENCEPHALOCELE are rare congenital tumours, formed by a protrusion of the membranes of the brain through an unossified part of the skull. They are believed to be dependent upon hydrocephalus, the excess of fluid in the sub-arachnoid space or in the ventricles of the brain leading respectively to a protrusion of the membranes alone (*meningocele*), or of the brain also (*encephalocele*). In the latter instance, the dilated ventricle may extend into the protruding portion of brain, a condition further distinguished as *hydrencephalocele*. The protrusion is most common in the occipital region, just behind the foramen magnum, between the four centres from which this part of the bone is ossified; next, at the root of the nose, between the frontal and nasal bones; but it may occur in any situation in the course of the sutures and even project into the nasal fossæ or pharynx. *Symptoms.*—In the occipital region these tumours are generally pedunculated and of large size—sometimes nearly as large as the child's head; at the root of the nose they are usually small and sessile. The skin covering them is generally normal. They swell up when the child cries, and can be completely or partially reduced on pressure, the reduction producing convulsions or other brain symptoms. When they contain fluid only (*meningocele*) they are soft, fluctuating, translucent, and completely reducible on pressure; they rarely pulsate, and are generally pedunculated. When they contain brain-matter (*encephalocele*) they are doughy, non-fluctuating, opaque, and only partially reducible; they pulsate, and are usually sessile. They may be mistaken for other tumours of the scalp, but especially for congenital dermoid cysts and degenerate nævi. However, their intimate connection with the bone, their situation in the course of the sutures, and their partial or complete reducibility, together with the facts that they swell up on expiratory efforts, and occasionally pulsate synchronously with the brain, will usually serve for their diagnosis. Further, the hole in the skull may at times be detected and brain symptoms be produced by pressure. *Treatment.*—As a rule they should be left alone, or merely supported by a pad and bandage. When pedunculated, and apparently communicating with the interior of the cranium by a small aperture only, they may be injected with Morton's fluid, or ligatured, or removed. Little success, however, has hitherto attended operative measures.

Fungous tumours, generally of a sarcomatous nature. and springing either from the tissues of the scalp or pericranium, or from the diploë or dura mater and then penetrating the bone, are occasionally met with, and may be mistaken for inflammatory affections of the pericranium or bone, or for syphilitic gummata. Their rapid growth, resistance to syphilitic remedies, escape of blood only on puncture, and the concomitant loss of weight and strength of the patient, will usually serve to distinguish them: but an exploratory incision may in some cases be necessary to clear up the diagnosis. Secondary tumours which pulsate and have the structure of thyroid-gland tissue, are also very occasionally met with in cases of hypertrophic goitre. *Treatment.*—Where there is no evidence of dissemination, and the tumour is small and fairly circumscribed, it may be removed. When growing from the scalp this can usually be done without much difficulty; but when the growth arises from the bone or dura mater a much more serious operation will of course be required, since a considerable portion of the skull will have to be cut away and the dura mater probably opened. It need hardly be said that the strictest antiseptic precautions must be observed.

DISEASES OF THE BRAIN THAT MAY CALL FOR SURGICAL INTERFERENCE.

ABSCESS in the brain is generally the result of a head-injury or of middle ear disease, and when its situation can be localized with a fair amount of probability imperatively calls for surgical interference. *See* Intracranial Suppuration and Complications of Middle Ear Disease.

TUMOURS of the brain are generally of the nature of glioma, but sarcomata also occur, and gummata and tuberculous new formations are not uncommon. The signs, diagnosis, and localization of cerebral tumour come more under the province of the Physician than of the Surgeon, and all that need be said here is that the chief signs are vomiting, persistent headache, optic neuritis, localized spasms or paralysis, and epileptiform convulsions, the convulsive seizures usually starting at the part supplied by the cortical centre involved in the growth. Where, from a consideration of the symptoms, a tumour is believed to be fairly circumscribed and in an accessible situation, and syphilis and tubercle have been excluded, the skull should be trephined, a sufficient portion of the bone removed by a Hey's saw or surgical engine to fully expose the growth, and the latter cautiously but freely cut away. *See* Trephining, p. 351.

DISEASES OF THE EAR.

By A. E. CUMBERBATCH, F.R.C.S., Aural Surgeon to St. Bartholomew's Hospital.

PHYSICAL EXAMINATION OF THE EAR.—In making an examination of a patient, let him be seated between the Surgeon and the source of light, with the affected ear towards the examiner. Throw the light on the ear and notice any abnormal condition of the auricle or the external meatus. Next grasp the auricle between the middle and index fingers, the speculum (Fig. 158), between the index finger and thumb, and pulling the auricle upwards and backwards, insert the speculum with a gentle rotatory movement. Any epithelium or wax that may obstruct the view should be removed by means of forceps (Fig. 159), or the syringe. If the canal be unobstructed, the membrana tympani can be seen stretching across its deeper part as a delicate bluish-grey or yellowish-grey semitransparent and highly polished film. Near the upper and anterior margin is a whitish prominence—the *processus brevis*, and running downwards and backwards from this, to a point just below the centre of the membrane is the *handle of the malleus*. From the tip of the handle a cone of light extends downwards and forwards, with its base to the periphery. From the processus brevis two indistinct lines extend backwards and forwards—the *anterior and posterior folds*. If the membrane be very thin or its posterior segment much retracted, the *long process of the incus* can be seen, posterior to and parallel with, the handle of the malleus. The portion of membrane above the anterior and posterior folds is called *Schrapnell's membrane*, and consists only of the dermoid and mucous layers. Whilst noting these points, carefully search the membrane for perforations, opacities, or small polypi.

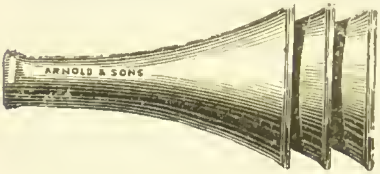


Fig. 158.—Aural specula.

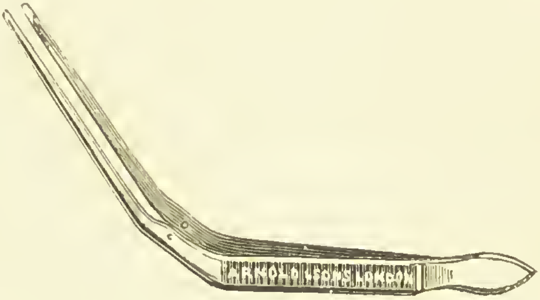


Fig. 159.—Aural-toothed forceps.

After thus inspecting the membrane, its mobility should be ascertained by means of 1, the pneumatic speculum, or 2, by forcing air into the tympanum through the Eustachian tube, either by (*a*) Valsalva's method, (*b*) by Politzer's method, or (*c*) by the catheter.

(*a*) *Valsalva's method* consists in making forcible expiration with the nose and mouth closed.

(*b*) *Politzer's method.* Direct the patient to take a mouthful of water; insert the end of the india-rubber tube into one nostril, carefully close tho unoccupied portion of this and the other nostril with the index finger and thumb; tell the patient to swallow, and sharply compress the bag (Fig. 160). In small children the tympanum can be inflated without their drinking water. Some patients find a difficulty in swallowing easily when told to do so; such persons should be made to say some guttural word such as "Huck."

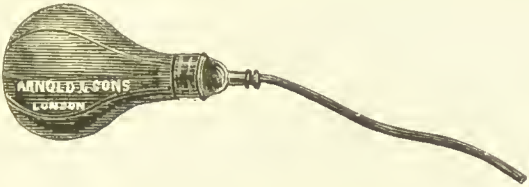


Fig. 160.—Politzer's bag.

(*c*) *To pass the Eustachian catheter* (Fig. 161), hold the instrument lightly between the forefinger and thumb and pass it quickly along the floor of the nose, keeping the point of the instrument downwards till it reaches the back of the pharynx; next draw it forward about three quarters of an inch, gently rotating outwards at the same time, till the point is felt to ride over the posterior lip of the Eustachian orifice, and further rotating it till tho ring of the catheter is in a line with the outer canthus of the eye, push the instrument slowly onwards, when the point will be in the Eustachian orifice. Another method for reaching the orifice of the tube is to draw the instrument forward

Fig. 161.—Eustachian catheter.

over the back of the soft palate till the point begins to ride over the posterior border of the hard palate, then turn it upwards and outwards as before. These are the two best methods. If the mucous membrane of the nose be very irritable, first paint the inferior meatus with a 4°/₀ solution of cocaine. Occasionally owing to post-nasal thickening or deformity of the septum, the catheter either cannot be passed, or else when passed cannot be turned. In such cases give the catheter a greater curve, and attempt to reach the tube through the other nostril.

When air enters the tympanum *freely*, it is heard distinctly to impinge on the tympanic membrane. If the Eustachian tube be *narrowed*, the air is heard but feebly, or not at all, to impinge on the membrane. If *fluid* be present, either in the tube or in the tympanum, a bubbling or gurgling sound is heard. If the tympanic membrane be *perforated*, the air is heard to whistle through the perforation.

To hear these sounds in the tympanum it is necessary while inflating to use the *diagnostic tube*, which is nothing more than a piece of india-rubber tubing 18 inches long, one end of which is inserted into the patient's, and the other in the Surgeon's, ear.

Having thus examined the condition of the external and middle ear, the next step is to ascertain if possible the condition of the auditory nerve. If a vibrating tuning-fork be applied to the vertex of the head in the middle line the sound is heard equally in both ears. In this case the sound is conducted directly to the labyrinth by the cranial bones. If now one meatus be closed by the finger, the sound is heard with greater intensity in that ear. The explanation offered of this phenomenon is that many of the waves of sound, prevented from escaping through the tympanum and meatus, are thrown back and intensified. If, then, a patient who is deaf on one side, hears the tuning-fork better with the affected ear, it may be assumed that the lesion is in the sound-conducting apparatus; while if he hears it better with the sound ear, some affection of the labyrinth or auditory nerve may be suspected.

Another way of testing the condition of the labyrinth is to place the vibrating fork on the mastoid process of the affected ear, and when the patient can hear it no longer for the surgeon to transfer it to his own mastoid, and note if he can still hear it himself. There are certain rare exceptions to the truth of what is here stated, but it is impossible to discuss the subject further in so limited a space. To complete the examination of a patient, test his hearing by means of the watch, and voice, and finally examine the nares and pharynx in cases where there is reason for suspecting that an unhealthy condition of these parts may be the exciting cause of the ear-mischief.

I. DISEASES OF THE EXTERNAL EAR. The auricle is liable to attack from various diseases, but it will only be necessary here to notice two: Eczema and Hæmatoma.

ECZEMA may be acute or chronic; primary, or secondary to eczema of the head. In the *acute form* there is great redness and swelling of the auricle; it is hot, tense, and tender, and later a crop of vesicles appear which exude a serous fluid soon drying into crusts; these, when they fall off, leave a raw surface. Acute eczema rarely invades the meatus. The *chronic variety* may attack the whole auricle; more frequently it is limited to some part of it. There is little or no redness, the surface is dry and scurfy, and fissured in places, and the disease generally spreads into the meatus, and sometimes even to the drum-membrane. In such cases there is more or less deafness, accompanied it may be by tinnitus, and a stuffy feeling in the ear. *Treatment.*—In the acute stage apply lead and opium lotion, or powdered zinc and starch in equal parts; later, useful applications are linimentum calcis, or ung. hydrarg. subchlor. (ʒj. ad ℥j). If the parts continue red and swollen, paint them with argenti nitratis (ʒss. ad aq. f℥j), and then apply powdered boracic acid, or ung. hydrarg. oxidi. rub. (gr. ij. ad ℥j.). Applications to the meatus must be applied with a small brush; the parts should be washed with oatmeal instead of soap. *Constitutional treatment* must not be neglected.

HÆMATOMA AURIS may occur spontaneously or as the result of an injury, and is not uncommon among the insane. It consists of an effusion of blood between the cartilage and perichondrium on the anterior surface of the auricle. It occurs as a hard and rarely fluctuating swelling, varying greatly in size. The skin over it is of a more or less livid hue, but occasionally is hardly discoloured. There is a feeling of warmth or tingling, but rarely of pain. After a time it gradually becomes smaller and may entirely disappear. Sometimes it suppurates. In the end the auricle is left more or less deformed. *Treatment.*—At first the application of ice or cooling lotions; some recommend tapping it and injecting iodine; others laying it open and dressing with a weak solution of carbolic or boracic acid. Of course, if it suppurates, it must be opened freely.

II. DISEASES OF THE MEATUS:—DIFFUSE INFLAMMATION is caused by injury, irritants (such as picking the ear), or sea-bathing. There is redness and swelling of the skin lining the meatus, a sense of fulness, and throbbing and occasional tinnitus, followed by serous or thin purulent secretion. After a time the epithelial lining becomes whitish and soddened, and, on syringing comes away in flakes, or even as a cast of the meatus, leaving the surface beneath red, and frequently obliterating the demarcation between the meatus and tympanic membrane. Rarely the tympanic membrane may be perforated. There is pain, increased by movements of the jaw or pressure on the auricle, and sometimes fever. *Treatment.*—In the early stages cold compresses, and a leech or two to the tragus; and antiphlogistics. As soon as secretion is established, instil a warm solution of boracic acid, and later equal parts of alcohol and water, or blow in powdered boracic acid. If the discharge prove obstinate, the surface may be painted with a solution of nitrate of silver (ʒss. ad f℥j).

FURUNCLES. Small boils frequently occur in the meatus in gouty, anæmic, and diabetic patients; also in those whose nervous system has been greatly taxed. The attack begins with pain, often of the greatest intensity, radiating over the side of the head and increased by movements of the jaw, or the slightest pressure on the auricle. There may be deafness as the result of closure of the meatus, not otherwise. Examination shows little or no redness, but one or more swellings, often closing the meatus. These are exquisitely tender, when touched. As soon as the abscess bursts the pain subsides, but very often one abscess after another forms, till the patient's life becomes a burden to him through pain and sleeplessness. *Treatment.*—Apply hot fomentations, a leech or two to the tragus, and instil a concentrated solution of boracic acid in alcohol. Often a plug of cotton wool soaked in glycerine and laudanum, and gently inserted into the meatus by the aural forceps shown at Fig. 162, or Gruber's medicated gelatine bougies, give relief. When the abscess is fully formed incise it, but not before, as early incision gives but temporary relief. The general health should be attended to, and full doses of opium given to procure sleep. Von Tröltsch recommends arsenic to prevent the recurrence of furuncles.

IMPACTION OF CERUMEN may be caused by narrowing of the meatus, cleaning the ears with the end of a towel or ear-pick, or the presence of a foreign body, such as a piece of cotton wool inserted into the meatus and forgotten. The chief *symptom* is partial or complete deafness, generally coming on suddenly. There may be tinnitus or even giddiness, often persistent cough, rarely pain. Sometimes the impaction of cerumen is really due to a peculiar laminated desquamation of the skin of the meatus, which becomes mixed with wax, and thus forms a plug. *Treatment.*—If the wax be not very hard it can be at once removed by syringing with warm water, the auricle being pulled backwards and upwards, and the nozzle of the syringe directed along the upper and posterior wall. If any difficulty be experienced in removing the wax owing to its hardness, soften it first by dropping into the ear for a few nights a warm solution of bicarbonate of soda (gr. x. ad f℥j.) After removal, gently dry the meatus with a cone of absorbent wool, and let the patient keep a piece in the meatus for a few hours.

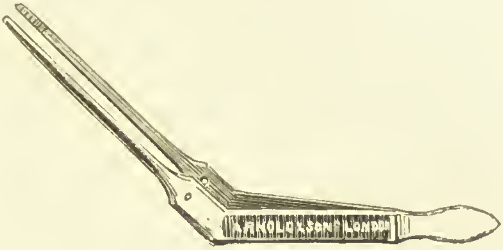


FIG. 162.—Aural forceps.

OTOMYCOSIS is a chronic inflammation of the external auditory meatus due to the presence of a vegetable fungus. The *symptoms* are a sense of fulness, tinnitus and occasional vertigo, more or less itching and occasionally pain. On examination there is seen a slight serous discharge, and the meatus contains yellowish or blackish flakes, on removal of which the skin beneath is found to be reddened and occasionally bleeding. The *Treatment* consists in frequently syringing with a warm solution of perchloride of mercury (1 in 1000), or chlorinated lime (gr. ij ad f℥j), or hyposulphite of soda (gr. iv ad f℥j), and, when the meatus is thoroughly freed from the flakes, instilling alcohol.

AURAL EXOSTOSES may roughly be divided into the spongy and the ivory.

(*a.*) The *Spongy* are single and generally pedunculated; are most commonly found at the junction of the cartilaginous and bony meatus, are rapid in growth, follow suppuration of the middle ear, and are frequently the result of ossification of granulations. *Treatment.*—They can generally be removed by seizing them with a pair of forceps and breakin them off.

(*b.*) *The ivory exostoses* or rather *hyperostoses* may be single, but are more often multiple. They vary from ridge-like elevations to rounded tumours with broad bases; they are found near the orifice of the meatus, more or less blocking up the canal, and grow slowly. Syphilis, gout, irritation of the meatus, and sea-bathing are said to be the *exciting causes. Treatment.*—They should not be interfered with unless they cause deafness, by completely closing the meatus, except in those rare cases where they are associated with discharge. In such cases where they greatly lessen the lumen of the canal they should be removed to avoid the risk of pent-up matter. When their removal is necessary, this should be done by means of a chisel and hammer, or the dental drill.

III. DISEASES OF THE MIDDLE EAR:—ACUTE CATARRH may be started by any condition which produces acute naso-pharyngeal catarrh, such as a severe cold, the exanthemata, &c. It may also be caused by sea-bathing, or by the use of the nasal douche. *Symptoms.*—The attack begins with a feeling of fulness in the head, followed by pain, which varies in character from a dull aching to a severe throbbing or stabbing; there is more or less deafness and sometimes tinnitus, and even giddiness, and in severe cases febrile disturbance. On examination, the membrane shows at first but little change beyond a slight loss of lustre, and the presence of a fine streak of red along the posterior edge of the malleus-handle. In severe cases the posterior segment of the membrane and the adjacent meatus are red, and this redness may spread over the entire membrane till the outline of the malleus-handle is lost. Vesicles and even small abscesses may form on its surface. Later the epidermis is loosened in white flakes, and finally the membrane distinctly bulges, when the effusion of fluid is great. The Eustachian tube is closed by swelling of its lining membrane. After some days, varying with the severity of the inflammation, resolution begins, or the fluid (mucus or pus), bursts through the membrane, and is discharged into the meatus. *Treatment.*—The patient should be confined to the house, or even to his bed, according to the severity of the attack. An aperient should be at once given, and an astringent gargle. If the pain is severe, a leech or two should be applied to the tragus. Cold compresses should as a rule be avoided, but hot fomentations are grateful to the patient and generally useful. The ear may also be gently syringed with warm water. If there be distinct bulging the membrane should be incised, especially if the pain persists. If there be any tenderness over the mastoid, this should also be leeched. After the severity of the symptoms has subsided, the tympanum should be inflated daily by means of the air-douche, and if the discharge continues, the ear syringed with a warm solution of boracic acid (1—100), night and morning, and a lotion of sulphate of zinc (gr. v ad f℥j), or equal parts of rectified spirit and water instilled; or after syringing with warm water and drying the meatus with absorbent wool, powdered boracic acid may be blown in. If the catarrh is non-purulent the membrane is rarely perforated; but even if perforation occurs, the aperture speedily heals after the escape of the fluid. Inflation by means of Politzer's bag should be continued with decreasing frequency till the hearing is restored.

CHRONIC PURULENT CATARRH (popularly called *Otorrhœa*), follows the acute form of disease. After freeing the ear from discharge, the membrane appears thickened, yellowish from the presence of sodden epithelium, or if this has been removed, reddish in hue. In some part of it a perforation can usually be detected varying in size, the margins granular or clean cut. If large, the lining membrane of the tympanum can also be seen, varying in colour from pale pink to dark red, according to the degree of inflammation present. When very small and situated anteriorly the perforation sometimes cannot be seen, but its existence can be proved by inflating the tympanum and listening with the diagnostic tube. The amount of deafness present in chronic purulent catarrh varies greatly. There is rarely tinnitus, but giddiness is far from uncommon. It is in this form of disease that patients are specially liable to the complications which will be considered later. *Treatment.*—After attention to the general health, the most important part of the treatment is great cleanliness. If a quantity of half-dried secretion mixed with epithelial *débris* be found in the meatus, this should first be removed by the instillation of warm bicarbonate of soda (gr. x ad f℥j) for several nights, and then thoroughly syringing the ear. Next let the ear be syringed with warm boracic acid night and morning, and after drying the meatus, blow in powdered boracic acid. If this treatment be unsuccessful, then try an alcoholic solution of boracic acid; or if this causes pain, it may at first be diluted with an equal quantity of water. Or sulphate of zinc (gr. x ad f℥j), or acetate of lead (gr. iij ad f℥j) may be tried.

If the perforation be large and the mucous membrane of the tympanum much swollen, it should be touched with solid nitrate of silver, or a saturated solution of chromic acid. Often when the discharge has ceased, the membrane remains perforated, and there is considerable deafness. In such cases the hearing may be greatly improved by means of an *artificial membrane.*

Without here discussing how the artificial membrane acts, it is sufficient to say there are two kinds, known as Yearsley's and Toynbee's. 1, *Yearsley's* consists of a piece of moistened cotton wool, rolled into an elongated plug, and applied with a pair of forceps specially designed for the purpose (Fig. 163). 2, *Toynbee's* consists (Fig. 164) of a disk of soft india-rubber with a piece of silver wire attached to the centre. The former has the advantage of being less irritating to the ear, and can be moistened with

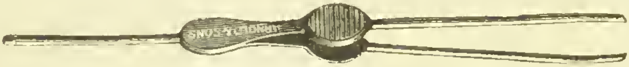


FIG. 163.—Forceps for inserting artificial drum.

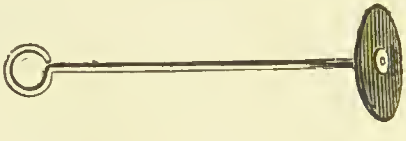


FIG. 164.—Toynbee's artificial drum.

medicated fluids, should any discharge still persist, but it has the disadvantage of being more difficult to apply. Toynbee's is easily applied, but is more irritating to the ear. There are various modifications of Toynbee's, the best being *Gruber's*. It is impossible to tell in any given case whether the artificial drum will succeed; this can only be ascertained by trial. When successful the artificial drum should only be worn at first for a few hours. The length of time should gradually be increased as the ear becomes accustomed to its presence. It should always be removed at night.

Various *complications* may arise in the course of chronic purulent catarrh. These are 1, polypi; 2, mastoid disease; 3, caries and necrosis; 4, meningitis and cerebral abscess; and 5, phlebitis and septicæmia.

(1.) Polypi may grow from the tympanic membrane, the meatus, or the tympanic cavity. Only the last are true polypi, the others being granulations; but for brevity they will all be classed under the name of polypi. They vary much in size, being sometimes not larger than a mustard seed, at other times large enough to project beyond the external orifice of the meatus. They are usually bright red in colour, but may be pale pink, and when very large greyish-yellow. They bleed more or less readily when touched. The diagnosis is easily made, but care must be taken not to mistake a swollen and vascular membrane for a polypus. In case of doubt the mobility of the latter, when touched with a probe, will settle the point. *Treatment.*—Polypi growing from the tympanic membrane should be destroyed with a saturated solution of chromic acid applied by means of a piece of cotton-wool twisted round a fine pair of forceps (Fig. 162). When the growth springs from the meatus, and is not too far in, it can easily be pinched off with a pair of aural forceps; when deeper in, it can be scraped off with a small sharp spoon. Those of larger size, especially when arising in the tympanic cavity, should be removed by the snare (Fig. 165). If the growth be of large size, of long duration, and firm in structure, it is most easily

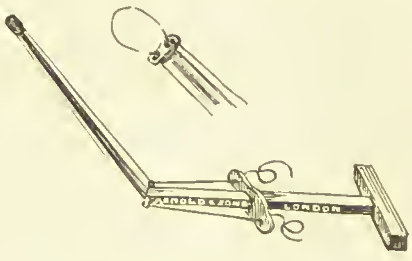


Fig. 165.—Polypus snare.

removed by seizing it with a pair of dressing-forceps, and slowly twisting it round on its own axis. Care must be taken to fix the patient's head, to avoid sudden movement on his part. However removed, the root of the polypus must be touched with a saturated solution of chromic acid or perchloride of iron till it is quite destroyed. During the time occupied in destroying the root, the ear must be syringed twice a day with warm water, and alcohol dropped into the meatus and retained there some minutes.

(2.) Mastoid disease. Not unfrequently inflammation of the tympanum spreads to the mastoid cells. The *symptoms* are deep-seated pain, tenderness on pressure, and when the periosteum is involved, redness and swelling; and the ear projects more or less unduly from the side of the head. In many cases, after a while, there is fluctuation, and on opening the abscess, the bone beneath is felt to be bare. Sometimes there is a fistulous opening communicating with the mastoid cells. If the abscess is not opened, the matter may burrow downwards beneath the sterno-mastoid, or backwards beneath the muscles attached to the occiput. In severe cases there may be signs of cerebral irritation. Sometimes the signs are very obscure, there being little indication of the mischief beyond deep-seated pain, tenderness on making firm pressure, and some fever. It is in such cases that the matter may burst into the cranial cavity. Occasionally the inflammation subsides, while the inflammatory products ossify, and convert the mastoid cells into solid bone. *Treatment.*—In the early stages apply hot fomentations and leeches, and as soon as fluctuation can be detected, make a free incision into the swelling, and encourage the discharge from the tympanum by frequent syringing with warm water. In obscure cases, if the pain persists, and the temperature keeps above the normal, trephine. There is little danger in trephining the mastoid cells, if care be taken to avoid wounding the lateral sinus.

(3.) Caries and necrosis.—The parts of the temporal bone most frequently attacked are, the mastoid process, the posterior wall of the meatus, and the roof of the tympanic cavity. It is generally easy to make a diagnosis, but when the deeper parts are affected it may not be possible to do so with certainty. The points that will help the surgeon are, facial palsy, the persistence of offensive discharge in spite of cleanliness, and granulations resisting all attempts at destruction. Even then it may be necessary to put the patient under an anæsthetic, and carefully examine with a probe. *Treatment.*—If the diseased bone can be reached without further injuring the hearing, it should be freely scraped or removed.

(4.) MENINGITIS AND CEREBRAL ABSCESS.—Although meningitis and cerebral abscess may supervene in the course of acute purulent catarrh of the middle ear, it is generally in the course of the chronic disease that they arise. If in the course of chronic suppuration, headache, rigors and rise of temperature supervene, we may strongly suspect intracranial mischief, and if in addition there is photophobia, sluggish pupils, and optic neuritis, the diagnosis is all but certain. *Treatment.*—If the seat of the abscess can be localized with any probability (see p. 346), the skull should be trephined, and an attempt made to reach the pus (see p. 350).

(5.) PHLEBITIS AND SEPTICÆMIA.—When *phlebitis* follows chronic suppuration of the middle ear, the veins usually involved are the lateral sinus and internal jugular. When the jugular is involved, there is tenderness over the course of the vein, and sometimes swelling of that side of the neck. For the symptoms of *septicæmia*, see p. 144.

CHRONIC NON-PURULENT CATARRH.—By far the largest proportion of cases of deafness met with are due to chronic catarrh. So many pathological conditions are included under this heading, that it is impossible to do more than give a very general outline of the symptoms. The affection may result from an acute attack, but more generally is a chronic affection from the very first. Heredity, syphilis, gout, rheumatism, and gestation, are predisposing, and perhaps in some cases, exciting causes. Large doses of quinine long continued, may also be an exciting cause. The disease at first progresses so insidiously, as often to remain unsuspected for some time. In many cases, tinnitus is the first and perhaps for a time the only symptom. More often, however, the earliest symptom is slight difficulty of hearing general conversation; later there is tinnitus, at first intermittent, afterwards persistent. Gradually the deafness increases till it becomes marked. This deafness varies greatly with the state of the weather and the patient's general health. There is rarely pain, and when present, it is transient, and never severe. There is often a sense of tightness in the head, and a feeling as if the ears were stopped with cotton wool. Sometimes there is giddiness, and some patients hear perfectly in a *vibrating* noise, as for instance in a railway carriage. On inspection the meatus is dry and shining; and occasionally it contains impacted cerumen, the removal of which however brings no improvement in hearing. The membrane varies greatly in appearance. At times it is normal, oftener more or less opaque; rarely is there any sign of congestion. The anterior segment may be retracted, the handle of the malleus being sharply defined, or the entire membrane may be cupped, and the handle drawn inwards and backwards. Opacities, calcareous deposits, and thinned spots are often seen. The cone of light may be altered in direction, may be broken into points, or may disappear. Rhinoscopic examination may show the naso-pharyngeal mucous membrane swollen, congested, and granular, or pale and dry. Adenoid vegetations may be present. The Eustachian orifice may be obliterated by cicatricial bands, or variously distorted. Inflation may prove the canal patent, or more or less obstructed. If the labyrinth be not seriously involved, the tuning-fork is heard louder in the affected ear. *Treatment.*—The nasal cavity and pharynx should be examined and as far as possible restored to a healthy condition (see diseases of nose and pharynx). The patency of the Eustachian tube must be restored, if possible, by means of the air-douche, catheter, or electric bougie. The nostrils should be syringed through with warm saline solutions, and astringent gargles when necessary should be given, or the throat painted with nitrate of silver, chloride of zinc or glycerine of tannin. If these means fail, the chloride of ammonium inhaler may be tried, or medicated fluids may be injected into the tympanum, such as bicarbonate of potass, iodide of potassium, vapour of iodine, or pilocarpine, although I cannot say I have observed much benefit from their use. Some Surgeons recommend, in obstinate cases, perforating the membrane, and dividing the tensor tympani, the posterior fold, or the anterior ligament of the malleus.

IV. Diseases of the internal ear.—Our knowledge of diseases of the internal ear is still so imperfect, and our means of treatment so inadequate, that this part of the subject need not be discussed at any great length. Diseases of the internal ear, although often primary, are more frequently secondary to diseases of the middle ear. *The causes are*:—1. General diseases of the system, especially the zymotic diseases, such as scarlet-fever, measles, mumps, typhus, diphtheria, &c.; also anæmia, lactation, and especially syphilis. 2. Extension from the middle ear, either directly, or indirectly by causing reflex vaso-motor changes in the labyrinth. 3. Intracranial mischief, such as aneurism of the basilar artery, meningitis, abscess, or tumours. 4. Sudden loud noises, such as heavy artillery firing. 5. Great emotion; and 6. Continued use of large doses of quinine. The *chief points of diagnostic value* are:—1. The vibrating tuning-fork placed on the middle line of the head is heard *less distinctly* with the deaf ear, or if both ears be affected, is not heard at all. 2. The tuning-fork when it has ceased to be heard through the cranial bones, can still be heard when placed opposite the meatus. 3. The tuning-fork when it has ceased to be heard by the patient, can still be heard by the Surgeon. 4. The patient hears the tick of the watch proportionately better than speech. 5. There is generally nausea or vomiting, giddiness, and always tinnitus. None of these signs and symptoms when taken separately are of much value, but when taken together, they are strong presumptive evidence of mischief in the internal ear.

MENIÈRE'S DISEASE is a sudden hæmorrhagic effusion into the labyrinth. The *symptoms* are very marked. The patient whose hearing was perfect before the attack is suddenly seized with intense tinnitus and giddiness, often so great as to cause him to fall. The giddiness is followed by nausea or actual vomiting, faintness, and cold sweats. On recovering somewhat, he finds he is deaf with one ear. The giddiness sooner or later passes off, but the tinnitus and deafness persist. If the deafness is absolute, the tinnitus may eventually disappear. *Treatment.*—Quinine, bromide of potassium, subcutaneous injection of pilocarpine, and electricity are recommended; but all treatment directed towards restoring the hearing is useless.

AUDITORY VERTIGO is characterized "by a sensation of motion, referred by the patient either to himself, or to surrounding objects, which seem to revolve in certain defined planes" (McBride). The attacks are generally paroxysmal, but often there is more or less constant giddiness, with occasional exacerbations. As may be seen above, auditory vertigo is a prominent symptom in Menière's disease, but many causes may give rise to the symptom, such as (*a*) increased pressure on the secondary membranes of the tympanum induced by accumulations of wax in the meatus, forcible syringing, or retraction of the membrana tympani due to obstruction of the Eustachian tube; (*b*) fluid accumulations in the tympanic cavity; (*c*) vascular and nervous changes, or effusion and secondary formations, in the labyrinth itself; (*d*) intra-cranial lesions; (*e*) dyspepsia, and (*f*) such drugs as quinine and salicin. *Treatment.*—The treatment consists in finding the cause, if possible, and attempting to remove it. When this is impossible, large doses of bromide of potassium, alone or combined with hydrobromic acid, will be found most efficacious. Next, quinine in large doses, but this must be carefully watched; and lastly, the use of the continuous current of electricity.

TINNITUS AURIUM arises under most varied conditions. The sounds complained of are very numerous, but may be divided into ringing, rushing, bubbling, and pulsating sounds. Any abnormal condition of the auditory apparatus will produce it, such as—1, accumulations of wax pressing on the drum membrane, 2, increased intra-labyrinthine tension, from undue pressure on the fenestræ (either by fluid in the tympanum, or retraction of the membrana tympani through obstruction of the Eustachian tube), or lastly, hyperæmia of, or pathological change in, the labyrinth. But in addition to these local causes, tinnitus may be produced by causes acting at a distance, such as anæmia, chlorosis, pulsating exophthalmos, aneurism of the vertebral artery, cerebral disease, large doses of quinine, or salicin. *Treatment.*—In every case it is important, if possible, to ascertain whether the cause is to be found in some derangement of the auditory apparatus, or elsewhere. If the cause be local, it is generally possible to relieve or cure the tinnitus by curing the local affection. If the tinnitus depends on general anæmia, some form of iron, with generous diet and the addition of stimulants may be sufficient to effect a cure. If there be hyperæsthesia of the nervous system, the bromides are indicated, with the addition of hydrobromic acid, if the singing is of a pulsating character. Tinnitus frequently occurs in patients of a rheumatic diathesis, and in such, antirheumatic treatment is, of course, indicated. Other remedies failing, the Surgeon, empirically, may try chloride of ammonium, nitrite of soda, and lastly, the continuous current of electricity.

DISEASES OF THE EYE.

By Walter H. Jessop, M.B., F.R.C.S., Surgeon to the Central London Ophthalmic Hospital.

Physical examination of the eye.—For the complete and thorough examination of the eye it is necessary that it should be examined:—(1) by the unaided eye or by focal illumination; (2) by the ophthalmoscope; (3) for acuteness of vision, fields of vision, colours, and tension. In all cases where possible each observation on the one eye should be repeated on the other for comparison.

1. Seat the patient in front of a window, or in a dark room with the lamp to the left and about two feet in front of him and direct and concentrate the light on his eye by a biconvex lens of about $2\frac{1}{2}$ inches focal length (*focal illumination*). First look at the lids, and tell him to open and shut them, also, with the eye open, to execute the various complete in, out, down and up movements of the eye to test the extrinsic ocular muscles. Along the edges of the lids look for the puncta which ought to be applied close to the ocular conjunctiva. Press near the inner canthus over the lachrymal sac to see if any discharge passes through the puncta. Evert the upper lid to examine its conjunctival surface by directing the patient to look down to the ground, laying a probe horizontally on the surface of the lid and then taking hold of the lashes and turning the lid over the probe. Pull down the lower lid to examine its conjunctival surface.

The ocular conjunctiva should be transparent-looking, and a few small vessels should be seen through it perforating the white or bluish sclerotic. Just external to the inner canthus is a small greyish-red projection, the *caruncle* and extending from it a pinkish fold, the *plica semilunaris.*

The vessels seen in inflammations of the eye may be divided into the following:—1. The *posterior conjunctival.* These are generally brick red in colour, tortuous, movable with the conjunctiva, and disappear on pressure. 2. The *sub-conjunctival* are branches or radicles of the anterior ciliary vessels and are divided into the *perforating* and the *episcleral.* The *perforating* arteries stop about $\frac{1}{10}$ inch from the corneal margin, and are well seen in glaucoma; the *episcleral* arteries form a pink zone of straight parallel vessels (*circumcorneal zone*) not disappearing on pressure, and are well marked in iritis and keratitis; the *episcleral veins* are dark, dusky looking, often in limited patches and are found in cyclitis, scleritis, &c. 3. The *anterior conjunctival* are superficial branches of the anterior ciliary. They are bright red in colour, found near the corneal margin, and indicate superficial corneal mischief.

Next examine the cornea, the depth and contents of the anterior chamber, and the iris as to its colour, polish and pupillary aperture.

The normal pupil is from 3·5 to 5 mm. in diameter, circular, regular, slightly to the nasal side of the centre of the cornea, and equal to and varying with its fellow under different degrees of illumination. The pupil should contract:—on light being thrown into the same eye (*direct light reflex*), on light being thrown into the opposite eye (*consensual light reflex*), and on accommodation or on the convergent movements of the eye associated with accommodation (*accommodation reflex*). It should dilate on one or both eyes being shaded, and also on stimulation of a sensory nerve (*sensory reflex*). Atropine, homatropine, &c. produce a dilated pupil (*mydriasis*) inactive to any of the reflexes; cocaine produces mydriasis, but the pupil still acts to the contraction reflexes; eserine, pilocarpine, &c. produce a contracted pupil (*miosis*) always dilating slightly on shading or on relaxation of accommodation. The pupil is influenced by the blood supply, and if there is congestion of the iris it is contracted (*congestion miosis*).

2. *Examination with the ophthalmoscope.*—The ophthalmoscope in its simplest form consists of a silvered glass concave mirror of about 20 centimetres focal length, with a central aperture (*sight hole*) of about 3 millimetres diameter, fitted on a suitable handle. If needed for estimation of refraction, lenses are arranged to pass behind the sight hole. The methods of using it are divided into (*a*), *direct*, and (*b*), *indirect*, and are much easier with a dilated pupil, and for this object homatropine or homatropine and cocaine should be used if possible. (*a*.) To use the *direct* method the patient should be sitting down with the light at first just above and behind the

head, the observer being about four feet away. Throw the reflection of the light from the ophthalmoscope-mirror through the pupil, and observe through the sight hole the pupillary area as a red colour (*red reflex*). On now slowly rotating the mirror horizontally and vertically a shadow is seen if the refraction is abnormal (ametropic), and this shadow moves in the same direction as the mirror in myopia, and in the opposite direction in hypermetropia and in myopia of less than one dioptre. (*Retinoscopy.*) Approaching closer to the patient examine the media, and observe if any objects other than retinal vessels are seen. If so, on telling the patient to move his eye in different directions, these objects, which are usually of a dark colour, will float about if they are in the vitreous. The lamp should next be moved on a level with the patient's head and on the same side as the eye under examination. On now bringing the ophthalmoscope to about 2 inches from the patient's cornea, and at the same time relaxing your own accommodation and telling him to look into the far distance and move his eye about as you direct, inspect the details of the fundus. If the patient has an error of refraction it is necessary to correct it by a suitable lens behind the sight hole. Now place a lens of nine dioptres behind the sight hole and investigate the vitreous and the posterior part of the lens, and one of twenty dioptres to see the cornea, anterior chamber, iris and anterior part of the lens.

(*b.*) The *indirect* method is perhaps easier to a beginner and gives an extensive and rapid view of the fundus, but is not so accurate as to minute details. At a distance of 18 inches look through the sight hole, your right eye at the patient's right eye, and *vice versâ*, telling him to look into the far distance (to relax his accommodation), in the same direction as the fingers holding the ophthalmoscope if the disk is to be examined, or at the sight hole if the yellow spot region is to be investigated. After obtaining the red reflex, hold up a lens of about $2\frac{1}{2}$ inches focal length between you and the patient and at about $2\frac{1}{2}$ inches from the patient's eye; an inverted view of the fundus will be thus obtained.

The following are the chief details to be observed in the normal fundus. The *optic disk* is greyish-pink, lighter than the rest of the fundus, and nearly circular in shape; its centre is sometimes stippled (*lamina cribrosa*), and often depressed (*physiological cup*), with the retinal vessels dipping into it. The periphery of the disk is usually lighter in colour (*scleral ring*) and often bordered in part by pigment. Occasionally an opaque white striated patch radiating from the edge of the disk is seen with its margin gradually thinning out (*opaque nerve fibres*). The rest of the fundus is bright red, with the retinal vessels on it, and sometimes the choroidal vessels seen plainly as a network and of a lighter colour than the retinal vessels. At the *yellow spot* the choroidal red is generally deeper in colour, and there are no blood-vessels. The *retinal arteries* are generally smaller and lighter in colour than the veins; both usually divide at a short distance from the disk into superior and inferior temporal and nasal branches. The retinal veins can often be seen to pulsate even in health, and by pressing on the eyeball with the finger the arteries can generally be made to pulsate also.

3. *Acuteness of vision.*—Snellen's test-types are those usually employed for testing vision, and are constructed so as to be seen under the smallest visual angle (5 minutes). Place the patient at 6 metres from the distance type, and if his vision is normal, he ought to read the smallest letters, numbered 6 on the types. His vision is thus called $\frac{6}{6}$, or 1. If he only reads the top letter it is $\frac{6}{60}$, or $\frac{1}{10}$, and so on. If the patient is under 45 give him the reading types arranged on the same plan, and find out the smallest he can read, and at what distance, thus finding his near point and accommodation. If he is too blind to see the type hold your fingers before his eye, and measure the greatest distance at which he can count them. Failing this shade his eye, and then throw light into it, and see if he has perception of light. If a patient has only perception of light, the observer should, by means of the ophthalmoscope-mirror in a dark room, throw light on to the different parts of his fundus to see if all are equally perceptive (*projection*).

The *fields of vision* for white and colours may now be found out by the perimeter, or roughly by the fingers. Any spots of the field in which the object used is not seen are called *scotomata*. The *colour vision* is usually estimated by coloured wools.

Intra-ocular tension may be estimated by instruments called tonometers, or by the fingers; the latter is the usual way, and is effected by directing the patient to look down on the ground, and then palpating the eyeball with both index fingers through the upper lid. Certain degrees of tension have been recognised, the firm, tense, semi-fluctuating feeling of the normal eye being taken as the mean, and are denoted +1, +2, +3, —1, —2, —3.

I. DISEASES OF THE EYELIDS AND LACHRYMAL APPARATUS.—CILIARY BLEPHARITIS (*Tinea Tarsi*) is the most common inflammatory affection of the lids; it is usually chronic, and occurs especially in ill-fed, hypermetropic, or strumous children. The *symptoms* are redness of the ciliary border of the lids, and either an eczematous condition of the border, or more commonly inflammation and vesication of the hair follicles with stunted and misplaced cilia, followed by scarring of the edge of the lid, and slight eversion. The best *treatment* is an alkaline lotion, as bicarbonate of soda, and a weak mercurial ointment applied along the edges of the lids night and morning; in bad cases removal of the lashes and painting the border of the lid with nitrate of silver solution.

The eyelashes may be the seat of the pediculus pubis, giving rise to a condition which may simulate ciliary blepharitis if there has been much irritation.

MEIBOMIAN CYST (*Chalazion*) is the most common form of tarsal tumour, and is due to chronic inflammation of the fundus of a Meibomian gland. It occurs as a small, hard, painless swelling, with the skin of the lid freely movable over it. On the conjunctival surface of the lid there is usually a bluish-grey discoloured spot, due to thinning of the tissues. A crucial incision should be made through this spot, and the semi-fluid contents evacuated by pressure or by a small spoon. These cysts have no cyst wall, are generally multiple, most common in young adults, and are very prone to suppurate.

STYE (*hordeolum*) is a localized inflammation of the cellular tissue of the lid usually about a cilium, but sometimes in connection with the duct of a Meibomian gland. It gives rise to throbbing pain, and swelling and œdema of the lid; it is usually succeeded by others, and is due to some derangement of the general health. It quickly disappears on evacuating the pus if present, or on pulling out the faulty lash.

ECCHYMOSIS OF THE LID (*Black Eye*), resulting from a blow, lasts about a fortnight before clearing up, and may be treated at first by iced compresses.

SYMBLEPHARON, or adherence of the palpebral conjunctiva to the ocular conjunctiva or cornea, may occur owing to inflammation following burns, wounds, and ulcerations.

CONGENITAL MALFORMATIONS of the lids are, *ptosis* (the causation of which is unknown), *epicanthus* (in which a fold of skin stretches across the inner canthus concealing the caruncle), *coloboma* (a deficiency of part of the lid), and absence of the eyelids.

THE MUSCULAR SYSTEM OF THE LIDS may be affected by spasm of the orbicularis palpebrarum (*blepharospasm*), paralysis of the orbicularis giving rise to inability to close the eye and epiphora, and paralysis of the levator palpebræ producing ptosis.

INVERSION OF THE EYELID (*Entropion*) is produced by some affection of the conjunctiva or tarsus, or by spasm of the palpebral portion of the orbicularis muscle. The most frequent result of entropion is *trichiasis* (turning in of the lashes) giving rise to pannus, ulceration of the cornea, &c.

EVERSION OF THE EYELID (*Ectropion*) is due to atrophy of the palpebral portion of the orbicularis muscle, to swelling of the conjunctiva, or to cicatricial contraction. Numerous operations have been planned for ectropion and entropion and the consequent faulty position of the lashes.

In addition to the above affections, the eyelids may be acutely inflamed and swollen owing to erythema, erysipelas, acute cellulitis, herpes ophthalmicus, and abscess; they may also be the seat of malignant (rodent and epitheliomatous), lupous, and syphilitic (primary and tertiary) ulcers. Yellow patches of xanthelasma, especially over the inner canthus, are found in elderly people. The lids may also be affected by molluscum contagiosum, warts, translucent cysts, and cutaneous horns.

The LACHRYMAL APPARATUS consists of the lachrymal gland and its ducts situated at the upper and external angle of the orbit, and the drainage system, which includes the puncta, canaliculi, lachrymal sac and nasal duct.

The *lachrymal gland* may be the seat of acute or chronic inflammation, and may also be affected by hypertrophy, or sarcoma.

The chief lachrymal troubles, however, are associated with the drainage system, and the most marked symptom is that of watery eye (*Epiphora*). The *puncta* may be everted or inverted by changes in the lid, or stenosed from inflammation, &c. The *canaliculi* may be narrowed by inflammatory changes or cicatrization after injury, or obstructed by cilia, concretions, &c. The entrance of the canaliculi into the sac is a very common place for stenosis. The *lachrymal sac* may be affected by inflammation spreading from the conjunctival or nasal mucous membrane. This is often accompanied by stricture of the nasal duct, and sometimes gives rise to a collection of mucus in the sac (*mucocele*), which presents as a fluctuating swelling near the inner canthus. On pressing over the swelling the fluid can usually be squeezed out through the puncta. A *lachrymal abscess* often follows a mucocele; the symptoms are then tense swelling and redness of the integument in the neighbourhood of the lachrymal sac.

The *treatment* for stenosis of the puncta or canaliculi is to employ probes or electrolysis, and if these methods fail, to slit up the canaliculus by a Weber's knife, removing a piece of the conjunctiva from the inner side of the incision with scissors. For stenosis of the nasal duct probes should be used to dilate it, and in many cases the use of styles for some time is advisable. In acute inflammation of the sac an incision should be made from the outside through the swelling, or the lower canaliculus should be slit up, and the pus, if found, evacuated that way; the sac should afterwards be syringed with antiseptic or astringent solutions.

II. DISEASES OF THE CONJUNCTIVA. — OPHTHALMIA (*Conjunctivitis*), or inflammation of the conjunctiva, is characterized by a feeling of grittiness, heat, heaviness and sticking together of the lids, injection of, and small hæmorrhages from, the posterior conjunctival vessels, and generally discharge from the eye.

1. PURULENT OPHTHALMIA (*gonorrheal ophthalmia; ophthalmia neonatorum*) is in almost all cases due to actual contagion with gonorrheal virus, the discharge then containing the gonococcus. It is a most serious affection and is characterized by the severity and rapidity of its onset, the period of incubation being from twelve hours to three days. The very copious discharge, at first watery, quickly becomes opaque and purulent, and is accompanied by severe conjunctival congestion, and brawny swelling of the lids. If these symptoms are not soon relieved the cornea ulcerates and perforates generally near its periphery, the eye being then lost for useful vision. *Ophthalmia neonatorum* occurs in newborn children generally on the third day after birth. It affects as a rule both eyes, and is due to inoculation from the vaginal discharges of the mother; to avoid this risk every

child's eyes should be thoroughly washed immediately after birth with an antiseptic solution. *The chief complications* of purulent ophthalmia are corneal ulcers, leukoma adherens, and panophthalmitis followed by shrinking of the globe. The *treatment* must be directed chiefly to washing away the discharge directly it is formed by antiseptic solutions, as corrosive sublimate, boracic acid, &c., and allaying the inflammation by ice-pads. The application of astringents as zinc or nitrate of silver solutions to the palpebral conjunctiva is indicated when the discharge is purulent. Ulceration of the cornea should be treated energetically by the actual cautery or nitrate of silver. If only one eye is affected, the opposite eye should be covered if possible by a watch-glass shade to prevent inoculation.

2. MEMBRANEOUS (*diphtheritic*) OPHTHALMIA is the most serious and virulent form of ophthalmia, and an eye may be destroyed by it in twenty-four hours. It is marked by great pain, excessive brawniness, and stiffness of the lids, owing to the plastic infiltration of the mucous and submucous surfaces. The palpebral conjunctiva is covered by a smooth grey membrane, and if this is stripped off, the surface still remains grey. The membrane lasts from 6 to 10 days, and is then followed by purulent ophthalmia. *Treatment.*—At first antiseptic lotions and warm fomentations, and then the usual treatment for purulent ophthalmia.

3. MUCO-PURULENT (*catarrhal*) OPHTHALMIA is characterized by the usual symptoms of ophthalmia and by more or less muco-purulent discharge; it occurs in epidemics and is contagious. There is often enlargement of the conjunctival follicles of the lower lid (*follicular ophthalmia*). It is best *treated* by slight astringent or antiseptic lotions, and by ointments to prevent the lids sticking together.

4. GRANULAR OPHTHALMIA (*Trachoma*) derives its name from the presence on the palpebral conjunctiva, especially near the fornix of the upper lid. of greyish bodies about the size of a pin's head. It may be acute or chronic. *The acute* form is raro in England and is accompanied usually by a muco-purulent discharge which generally absorbs the granulations and so cures the disease. In the chronic stage the *symptoms* aro a heavy look of the lids, irritable eyes, and perhaps slight muco-purulent discharge. The granulations often affect the submucous tissuc, giving riso to scarring. It may be *complicated* by

pannus, ulcers of the cornea, entropion, trichiasis, etc. *Treatment.*—In the acute stage antiseptic lotions; in the chronic stage painting the palpebral conjunctiva with silver nitrate solution or applying solid copper sulphate, in each case washing off the application afterwards. If there is a muco-purulent discharge astringent lotions as zinc should be ordered.

5. PHLYCTENULAR OPHTHALMIA is characterized by the presence on the ocular conjunctiva or on the anterior surface of the cornea of one or more papules or pustules surrounded by a limited vascular zone. It generally occurs in children, especially if strumous. Photophobia or lid-spasm may be present. The *treatment* is chiefly dietetic with the local application of yellow mercuric oxide ointment.

PINGUECULA is a yellowish elevation, not containing fat, of thickened conjunctiva and subconjunctival tissue near the inner or outer edge of the cornea.

PTERYGIUM is a triangular thickened piece of the ocular conjunctiva with its apex at the margin of or on the cornea. It is especially found in people who have been in the Tropics. If it invades the cornea it may be dissected off and the apex stitched back on the conjunctiva.

The *conjunctiva* may be the seat of primary or tertiary syphilitic ulceration, tubercle, lupus, amyloid degeneration, pemphigus, polypus, dermoid tumours, lepra and epithelioma.

The *lymphatic spaces of the conjunctiva* are often dilated in beaded chains or small cysts.

Wounds of the conjunctiva alone heal well, and if extensive ought to be stitched up.

III. DISEASES OF THE CORNEA AND SCLEROTIC.—KERATITIS, or inflammation of the cornea, is characterized, as a rule, by pain, photophobia, lachrymation, impairment of vision, pink circumcorneal vascular zone, and want of natural transparency of the cornea. It may be divided by its position into 1, superficial; 2, interstitial; and 3, posterior or punctate.

1. SUPERFICIAL KERATITIS is usually produced by irritation due to roughness or insufficient protection of the lids. The condition is often vascular (*pannus*). A rare and very painful form is accompanied by numerous small vesicles (*herpes of the cornea*). The *treatment* consists in the removal of the irritant, and in the application of sedative lotions as opium, belladonna, &c. In obstinate cases of pannus the operation of *peritomy* (removal of a ring of

conjunctiva round the corneal periphery to cut off the superficial blood supply to the cornea) may be performed.

Corneal Ulcer is a loss of substance due to limited inflammation of the corneal tissue. It is usually seated in the superficial or epithelial part of the cornea, though sometimes from the commencement it affects the corneal tissue proper, and is then generally produced by a limited collection of pus in the lamellæ of the cornea (*abscess or onyx*).

A corneal ulcer may be (*a*) simple, or (*b*) infective, and these may be central or peripheral, acute or chronic.

(*a*) The *simple ulcer* may be due to an abrasion of the cornea, a phlyctenula, &c., and is best treated when acute by atropine drops, unless it be deep and peripheral, when eserine or pilocarpine are to be preferred. When chronic, an ointment of yellow mercuric oxide should be placed in the eye once or twice a day, and massage employed.

(*b*) The *infective ulcer* tends to spread rapidly at its edges and also in depth; it is often accompanied by *hypopyon* (pus in the anterior chamber) and then is generally microbic in origin. The best *treatment* is the actual cautery or solid nitrate of silver applied to the edges and base; the evacuation of the pus in an adult by tapping the anterior chamber from below; and the local application of belladonna or atropine.

2. Interstitial keratitis is usually associated with hereditary syphilis, sometimes with struma, and occasionally with acquired syphilis. The whole cornea undergoes a subacute or chronic inflammation, and at first looks steamy and then patchy and like ground glass; it usually becomes vascular (*salmon patches*), but there is no tendency to superficial ulceration or suppuration. After some months the eye begins to clear up under treatment, even in very bad and apparently hopeless cases. Though as a rule one eye is attacked first, the other after a few weeks or months generally becomes affected. The usual age is between 5 and 16. The attendant *complications* are iritis, secondary glaucoma, uveitis, and in very bad cases shrinking of the eyeball. After an attack there are generally to be found nebulæ in the cornea, and always the remains, at the corneal periphery, of the vessels of inflammation. The *treatment* is usually small doses of mercury over a long period, or iron tonics, and locally atropine and yellow oxide of mercury ointment.

3. Keratitis Punctata is probably never present without disease of the uveal tract. It is characterized by

the presence of dots of different sizes on the epithelium of Descemet's membrane. These are generally arranged in the lower half of the cornea in the shape of a conical bullet with the apex upwards. The dots may be proliferations of the posterior corneal epithelial cells, or granules, &c., deposited on the epithelium.

The *results* of keratitis are often to be found in the corneal tissue as small branching lines (remains of vessels), greyish opacities (*nebulæ*), and dense white patches (*leukomata*). The use of lead lotion in keratitis is especially prone to give rise to leukomata. In cases of perforating ulcer, the iris may become adherent to the cornea, a condition known as *anterior synechia*, or if the corneal scar is white, as *leukoma adherens*. The other results are conical cornea, and bulging of the cornea and sclerotic (*anterior staphyloma*).

ARCUS SENILIS is a greyish ring of fatty degeneration of the corneal tissue extending round the cornea near its periphery; it has no special pathological importance, and occurs as a rule in elderly people.

CONICAL CORNEA (*keratoconus*) is a bulging of the central portion of the cornea. It generally occurs in females, and is due to defective nutrition of the corneal tissue. It may follow an ulcer, especially if central. Operative procedures, as iridectomy, trephining, &c., rarely do any good, and the same may usually be said for concave and stenopaic glasses.

FOREIGN BODIES on the cornea should be removed by a needle under cocaine anæsthesia.

SCLERITIS (*episcleritis*), or inflammation of the scleral tissue, is accompanied by a circumscribed reddish-purple patch of vascular congestion about 2 to 3 mm. from the corneal margin, generally on the outer side. It lasts as a rule from 5 to 8 months, and often relapses; the pain and tenderness vary much in intensity, and in severe cases iritis is usually present. It is more common in women than men, and affects those of the rheumatic, strumous or syphilitic diathesis. The best modes of *treatment* are warm fomentations of opium, leeches, massage, belladonna and atropine if iritis is suspected, and general constitutional remedies.

WOUNDS of this region may be divided into (*a*) corneal, (*b*) sclero-corneal, and (*c*) scleral. (*a*) *Corneal wounds*, unless implicating the lens or iris, generally heal quickly. (*b*) *Scleral wounds* more than $\frac{1}{4}$ inch behind the sclero-corneal junction, if small and unaccompanied by the presence of a foreign body in the eye, may be stitched up, or the conjunctiva stitched over them, and then treated by ice-pads to allay inflammation. (*c*) *Sclero-corneal wounds* are the most dangerous, owing to the great risk of sympathetic inflammation, and demand great judgment in saving the eye, as in most cases the eye ought to be excised, especially if the lens is injured.

TUMOURS of this region, as dermoids, epithelioma, and lepra, usually have their seat at the sclero-corneal junction.

IV. DISEASES OF THE UVEAL TRACT.—The uveal tract comprises the iris, ciliary body and choroid, and though disease may be limited to one part, there is always a tendency for it to spread through the whole tract.

IRITIS OR INFLAMMATION OF THE IRIS may be acute. subacute or chronic. The usual *symptoms* of a case of acute or subacute iritis are—neuralgic pain along the ophthalmic division of the fifth nerve, dimness of sight, lachrymation, occasionally photophobia, and injection of the episcleral vessels, giving rise to a pink circumcorneal zone. The iris is dull, and discoloured (thus a blue iris becomes green), the pupil is sluggish, contracted, generally irregular owing to adhesions to anterior capsule of the lens (*posterior synechiæ*), and acts badly or not at all to atropine. In chronic iritis there may be no symptoms except irregularity of pupil, dimness of vision, and at times pain. Iritis is especially likely to occur in patients suffering from syphilis, rheumatism, or gout; it may also have a traumatic origin, or be secondary to inflammations of the cornea, sclerotic, or the other parts of the uveal tract. The iritis associated with *syphilis* is often symmetrical, and generally accompanied by great effusion of lymph in the neighbourhood of the pupil (gummata), but in the secondary stage of this disease this symptom may be absent. Iritis in *rheumatic* patients is usually very painful, and apt to recur. Generally both eyes suffer in repeated attacks. It is occasionally accompanied by fluid hypopyon. It especially attacks those of the rheumatic diathesis suffering from prolonged gonorrheal discharge. In *gouty* subjects there may be a very insidious form (*quiet iritis*), and sometimes the anterior chamber may be filled with a spongy gelatinous mass.

The *local treatment* is first directed to obtaining dilatation of the pupil by atropine or atropine and cocaine combined; if there is much congestion of the conjunctival vessels it is well to apply one or two leeches to the temporal region about one inch from the external canthus. The *general treatment* is that applicable to the diathesis of the patient, but a mild course of mercury is by some always prescribed in acute iritis.

THE CHIEF TRAUMATIC AFFECTIONS of the iris are blood in the anterior chamber (*hyphœma*), *mydriasis* (due to paralysis of the sphincter pupillæ), tremulous iris (generally due to dislocation of the lens), rupture of the ciliary border of the iris (*coredialysis*), a rent in the pupillary border, and prolapse of the iris after a perforating wound.

THE CONGENITAL ABNORMALITIES are difference in colour in both irides, irregularity in shape and position of pupil, multiple pupils (*polycoria*), remains of pupillary membrane, *coloboma* (deficiency of part of iris) generally down and in, often combined with coloboma of the choroid, and *irideremia* (absence of iris).

The iris may be the seat of tubercle, nævus, cysts, and melanotic sarcoma (rarely primary).

IRIDECTOMY.—This operation may be performed (*a*) to improve the sight in cases of corneal opacity, anterior polar cataract and zonular cataract, (*b*) as a remedial measure in glaucoma, relapsing iritis, and complete posterior synechia, and (*c*) in cataract extraction.

Operation:—The patient is recumbent, the operator standing behind the patient's head if ambidextrous, or if operating on the right eye. General or local anæsthesia is induced, and after introducing the spring speculum, fix the conjunctiva near the cornea with forceps exactly opposite the place selected for the coloboma. Pass the keratome by pressure perpendicularly through the cornea (Fig. 166), and then lowering the handle of the knife, pass the blade into the anterior

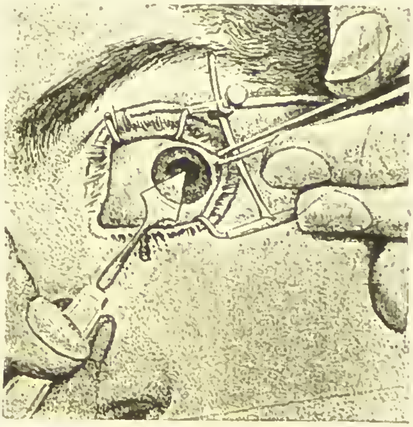


FIG. 166.—Showing speculum in eye, fixation forceps in position, and the keratome passed into the anterior chamber in the operation of Iridectomy downwards and inwards.

chamber parallel to the iris; now lower the handle still more till the point nearly touches the posterior surface of the cornea and then slowly withdraw the knife. Give the fixation forceps to an assistant to gently depress the eye; pass through the wound the iridectomy forceps closed *with the points* directed towards the posterior surface of the cornea, open the forceps, seize the pupillary border of the iris, gently draw it out, and snip it off with the scissors either parallel to the wound, or at right angles to it across the cornea. Carefully return the edges of the coloboma with the curette, and bandage up the eye. In iridectomy for glaucoma it is necessary to have a large wound (some operators preferring a Graefe's knife), and to remove the iris up to the ciliary border by two snips.

Cyclitis, or inflammation of the ciliary body, rarely occurs without other parts of the uveal tract being involved. The *symptoms* are circumcorneal zone, pain and tenderness in the ciliary region, pain on accommodating, and often hypopyon and vitreous opacities. It is best *treated* by atropine and leeches.

Choroiditis, except as part of a more general inflammation, is rarely accompanied by external signs or severe pain. Ophthalmoscopically there may be, if recent, soft yellowish white exudation patches either at the yellow spot or elsewhere; these patches afterwards on clearing up leave as a rule atrophy of the choroid, showing the sclerotic through, and the edges bordered by disturbance of pigment. The atrophic patches may be ringed, diffused, or punctate, and if due to hæmorrhage from the choroidal vessels are generally large and deeply pigmented. The retinal vessels always pass over these patches of choroiditis. Vision is usually affected, but not always. The usual causes are syphilis (acquired and congenital), myopia, tubercle and hæmorrhages. In syphilitic cases mercurial treatment should be continued for a lengthened period.

Uveitis, or inflammation of the uveal tract, generally starts in the ciliary body, and is characterized by the chief symptoms of iritis, cyclitis, and choroiditis. It may be divided into (1), purulent, and (2), plastic.

1. Purulent uveitis (*panophthalmitis*) has usually a traumatic origin, but may occur in pyæmia and in old blind eyes. The symptoms are acute congestion and œdema of the lids and conjunctiva, extreme pain, and after a few days, if the media are transparent enough, a

yellowish reflex, due, as a rule, to suppuration in the vitreous, is seen through the pupil. The usual course is for the inflammation to affect the whole interior of the eye, and afterwards the extrinsic muscles and Tenon's capsule. The *treatment* is either immediate enucleation, or incisions into the eyeball to allow free vent to the pus. Meningitis has occasionally followed enucleation.

2. PLASTIC UVEITIS is characterized by a great tendency to deposition of lymph, and may be divided into Acute and Chronic.

(*a*) *Acute plastic uveitis* (*Sympathetic Inflammation*) is set up in one eye by morbid changes usually the result of a wound of the other eye. The injured eye is called the "exciting," and the other the "sympathizing eye." It occurs usually from 6 weeks to 3 months after injury. It is preceded as a rule by symptoms known as "Sympathetic Irritation," viz.—lachrymation, photophobia, dimness of sight, oscillations of the pupil and frontal neuralgia. The *symptoms* are impaired vision, circumcorneal zone, keratitis punctata, deep anterior chamber, iritis, papilloretinitis, and opacities in the vitreous. These symptoms are followed by thickening and vascularization of the iris, occlusion of the pupil by lymph, shallow anterior chamber, diminished tension, shrinking of the vitreous, detachment of the retina, &c. The prognosis is very unfavourable, as only in a few cases the changes stop short of actual loss of the eye for useful vision, and it must always be remembered that the *sympathizing* eye suffers as a rule more severely than the *exciting*. The nature of the disease is probably a microbic inflammation spreading from the exciting eye by the optic nerves and chiasma to the sympathizing eye. The *treatment* consists in confinement to a dark room, goggles, atropine, leeches and mercury. If the exciting eye is quite blind it should be excised, but if it has useful vision it should be saved.

(*b*) *Chronic plastic uveitis* occurs as a rule in strumous and syphilitic patients. The disease progresses like "Sympathetic Inflammation," but is more chronic; it usually affects both eyes at intervals, and often passes on to complete blindness. In young children plastic uveitis may produce a condition called "*pseudo-glioma*," which may be diagnosed as a rule from glioma by discoloration and adhesions of the iris, minus tension, &c. A less severe and more common form of chronic plastic uveitis may be called *Anterior Uveitis* (*Serous Iritis*) from its affecting the anterior part of the uveal tract. It is characterized by keratitis punctata, deep anterior chamber, often dilatation of the pupil, increased tension, and the usual symptoms of iritis and cyclitis, accompanied often by a few peripheral choroidal changes, and small vitreous opacities. It is generally found in young adults and is often associated with gout, rheumatism, and struma. The treatment is complete rest for the eyes, and atropine with careful watching of tension.

The *Uveal tract* may be affected in any part by sarcoma, (generally melanotic), but the usual primary ocular seat of sarcoma is the ciliary body or the choroid.

V. DISEASES OF THE CRYSTALLINE LENS.—CATARACT is the name applied to an opacity, complete or partial, of the lens, and is due to structural changes in the lens. Cataracts may be divided into *hard* or *soft*, according to their consistency, and this usually depends on age, as below thirty-five they are all "soft." They are called *primary* when independent of any other ocular affection, and *secondary* when following some other disease, as glaucoma, intra-ocular tumour, &c.

Though all cataracts at first are incomplete or partial, yet it is advisable to make a division of (1) complete (including those that in time tend to become complete), and (2) partial (those that do not, as a rule, tend to become complete).

(1) *Complete cataracts* are usually senile or hard, and are called, according to their mode of origin, nuclear, or cortical. The nuclear cataracts are often amber in colour, are characterized by an opacity at the nucleus of the lens, and are usually hard, except sometimes in diabetes; the cortical ones begin as flakes or streaks radiating from the axis of the lens. Congenital cataract may occur as a general opacity of the lens; it is usually binocular, and of course soft. A complete cataract may degenerate and its cortex become fluid (*Morgagnian Cataract*).

(2) *Partial cataracts* include (*a*) lamellar, (*b*) anterior polar, and (*c*) posterior polar.

(*a*) *Lamellar* (*zonular*) *cataract* is either congenital or forms in early life, and is generally associated with a history of convulsions or fits, and with a deficiency of the enamel of the teeth. The opacity is situated as a shell between the nucleus and cortex, which are both clear. It is usually symmetrical.

(*b*) *Anterior polar* (*pyramidal*) *cataract* is a dense white opacity at the anterior pole of the lens, usually due to perforation of the cornea in early life, and therefore associated with corneal nebula.

(*c*) *Posterior polar cataract* is situated at the posterior pole of the lens. It is generally of a radiating spoke-like nature, and is often associated with disease of the vitreous.

Diagnosis.—When a cataract is complete it looks white or grey, and may be best seen by dilating the pupil, and examining by focal light. When incomplete and cortical the striæ may be seen by oblique illumination if the pupil is dilated, or by throwing light into the eye by the ophthalmoscopic mirror (preferably a plane mirror), when the striæ will appear as black lines.

The *subjective symptoms* in incipient cataract are failing vision, black fixed spots or lines before the eyes, ability to see better in the dark due to dilatation of the pupil, myopia, and sometimes monocular diplopia or polyopia.

Treatment.—In incipient senile cataract, especially of the nuclear variety, atropine drops will often temporarily improve the sight. The operations for removal of the lens are of two kinds, namely *extraction* and *discission;* extraction is always preferred in hard cataracts, and sometimes in soft, especially in adults. It is of course necessary before proceeding to operation that the condition of the eye be satisfactory as far as the lids, conjunctiva, and lachrymal apparatus are concerned, and that there is good perception and projection of light. The general health of the patient must also be investigated, as senile cataract is often associated with gout, glycosuria, and arterial disease.

The *extraction operations* are numerous, but the only one described here will be the 3 millimetre flap operation, which may be performed with or without iridectomy.

Operation.—First steps as in operation for iridectomy (see p. 497). After the introduction of the spring speculum, the conjunctiva should be fixed with fixation forceps immediately beneath the cornea, the point of the Graefe's knife entered in the margin of clear cornea at the outer edge of a horizontal line 3 millimetres beneath the summit of the cornea (Fig. 167) and passed carefully across the anterior chamber to the inner corneal edge of the above horizontal line; the incision is finished in the corneal margin above by slow to and fro movements of the knife. An iridectomy is now performed if required (see p. 497). Fixing the eye, a cystitome (Fig. 168) is passed through the wound and the anterior capsule of the lens divided by horizontal incisions. The eye is now directed slightly downwards, and moderate pressure by a curette or spoon applied below the lower edge of the cornea till the upper edge of the lens presents in the wound (see fig. 169) and the lens is gradually delivered. The speculum is now removed and the lids closed for a brief time, when any soft matter is extracted by pressure from without, best by the lower lid, or with a curette. The iris is now carefully replaced by the curette, and both eyes bandaged up. The after-treatment consists in keeping the eyes bandaged for about a week, removing the bandages, and washing the lids gently every day. If there are any signs of iritis, characterized by pain and swelling of the lids, atropine and leeches must be prescribed, and if the cornea suppurates it should be cauterized or dusted with iodoform. The other complications are prolapse of

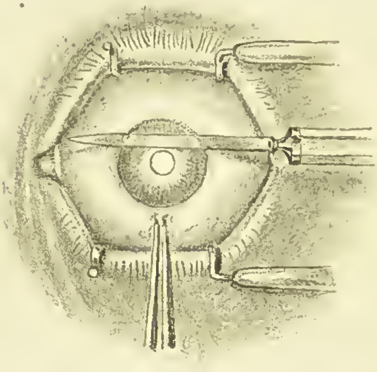


FIG. 167.—Showing speculum in eye, fixation forceps, and Graefe's knife in position for performing flap section in cataract extraction, and also line of flap.

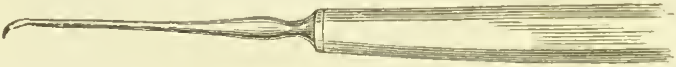


FIG 168.—Cystitome.

the iris, hæmorrhage into the vitreous, and panophthalmitis. After two months the vision should be tried for glasses, and if there is much membrane left in the pupillary area, producing unsatisfactory vision, a *secondary* operation must be performed. This is done, the eye being under atropine and cocaine, by passing a needle through the cornea and breaking up the membrane.

The *discission operation* for soft cataract consists in needling the lens at intervals (generally two or three times), allowing the aqueous to absorb a certain amount of it (the eye being kept under atropine), and then letting out the lens matters by introducing a curette or syringe through a peripheral corneal section.

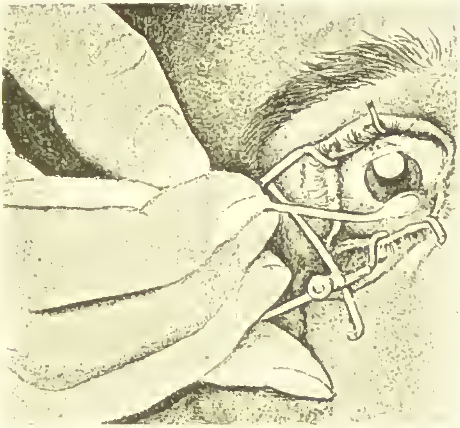


FIG. 169.—Showing the lens presenting in the wound from pressure by the spoon during the operation of Extraction.

The CHIEF INJURIES of the lens are (1) traumatic cataract due to rupture of the capsule and (2) dislocations of the lens (usually downwards but sometimes into the anterior or posterior chambers).

THE CONGENITAL DEFECTS OF THE LENS are as a rule symmetrical, and comprise cataract and dislocation.

VI. DISEASES OF THE OPTIC NERVE, RETINA, AND VITREOUS.—The optic nerve fibres may be divided into two sets, *axial* (for the supply of the yellow spot region) and *peripheral* (for the rest of the retina).

OPTIC NEURITIS, or inflammation of the optic nerve, may be acute or chronic, and attack the whole or part of the fibres of the nerve; and may be divided into (1) *papillitis* affecting the intraocular end of the nerve, and (2) *retro-bulbar neuritis* affecting the nerve behind the globe.

1. PAPILLITIS is usually double except when due to orbital mischief. The *symptoms*, chiefly ophthalmoscopic, are hyperæmia, swelling and haziness of the edges of the disk, distended and tortuous retinal veins, and small or normal retinal arteries. In extreme cases the retina also is involved (*papillo-retinitis*), the distended veins being covered in part by greyish-white striæ or opacities, the retina œdematous, with flame-shaped hæmorrhages often radiating from the disk, white plaques, &c. The vision may be normal or much reduced, and the field for vision is usually peripherally limited. The chief *causes* are cerebral and orbital tumours, orbital inflammations, tubercular meningitis, acute myelitis, syphilis, chlorosis, lead poisoning, and nephritis. The *treatment* is chiefly constitutional, but in uni-ocular papillitis incision into the nerve-sheath has by some been recommended.

2. RETRO-BULBAR NEURITIS may occur in one eye, due to orbital periostitis, &c., without at first any ophthalmoscopic symptom, the only sign being loss of sight and generally pain on movement of the eye. There is usually a central scotoma. As a rule symptoms of optic atrophy follow.

Chronic retro-bulbar neuritis (*toxic amblyopia*), affecting usually both eyes, is an inflammation of the axial fibres, and is found in persons using tobacco or alcohol, and perhaps in diabetes. The symptoms are diminution of vision usually of both eyes, the fields of vision being normal as to their periphery, but containing a central *scotoma* (blind spot) for red and green. By the ophthalmoscope there is usually no change to be seen. The patients complain of mist before the eyes, and of confusing gold and silver coins; they generally exhibit want of tone, &c. The *treatment* is directed to improve the general health, and to avoid the exciting cause.

ATROPHY OF THE OPTIC NERVE may be a primary disease, or secondary to some other optic nerve or retinal affection. By the ophthalmoscope the optic disk is white or greyish, often slightly cupped or filled up; the lamina cribrosa too plainly visible; the retinal vessels, especially the arteries, are too small; the vessels are accompanied by white streaks on each side; and if there has been swelling, the vessels are curved antero-posteriorly and often obscured in places; the scleral ring round the disk is too white and the edges of the disk are irregular. Atrophy may follow papillitis, retrobulbar neuritis, embolism of the central artery of the retina, retinitis (especially pigmentary), and glaucoma. A form called progressive atrophy is found in locomotor ataxia, insular sclerosis, general paralysis of the insane, and as a purely local disease; it is marked by concentric contraction of the fields of vision, loss of sight, colour blindness, and sometimes central scotoma. The treatment is generally anti-syphilitic remedies, hypodermic injections of strychnia, and galvanism, but the prognosis is as a rule very bad.

Injuries of the optic nerve may be due to a stab, blow, gun-shot wound, or fracture of the sphenoid bone.

Tumours of the optic nerve may be secondary to sarcoma of the choroid, or glioma of the retina affecting the intraocular end. Myxo-sarcoma is the most common form of tumour proper to the nerve trunk. Gummata and tubercle may affect the chiasma and nerves.

Retinitis, or inflammation of the retina, is usually accompanied by diminution of vision, and is characterized ophthalmoscopically by loss of transparency and haze of the fundus; soft white discreto or grouped spots; hæmorrhages of various sizes and shapes (striated or flame-shaped in nerve-fibre layer, large and semicircular in yellow spot region), and by vitreous opacities. Retinitis is associated with syphilis, nephritis, glycosuria, leukæmia, pyæmia (*purulent retinitis*) and with diseases of the circulatory system (*hæmorrhagic retinitis*). The *treatment* is chiefly constitutional, and the eyes must be shaded and used as little as possible.

Retinitis pigmentosa is a chronic and symmetrical disease, occurring in early life, characterized by night blindness, and great contraction of the fields of vision, even though the central vision be normal. Ophthalmoscopically the optic disk is "waxy" looking and atrophied, the retinal arteries are small, and there is much lace-work retinal pigment, especially near the equator. The loss of sight is progressive, and the disease generally ends in blindness.

Embolism of the central artery of the retina occurs usually on the left side and in connection with heart disease. Owing to this artery being a terminal one complete plugging of it is followed by total and sudden blindness. The ophthalmoscopic signs are pale optic disk, diffused retinal haze, bright red spot at yellow spot, and retinal arteries near disk very small and like white threads. The *treatment* is massage of the eyeball.

Thrombosis of the retinal artery or vein is of occasional occurrence; and after large doses of *quinine* blindness of both eyes has occurred with very small retinal arteries.

DETACHMENT OF THE RETINA is due to separation of the retina from its pigment epithelium by hæmorrhage or serous exudation. It is accompanied by defect in the field of vision corresponding to the detachment. With the ophthalmoscope the detachment looks greyish, and the retinal vessels passing over it elevated. The causes are myopia, blows on the eye, cicatrices following wounds, choroidal tumours, &c. *Treatment*, except complete rest, is usually unavailing.

GLIOMA OF THE RETINA occurs in early life, and the first symptom is a shining white or yellow reflex seen behind the pupil; by focal illumination there is found lobulated swelling, with small vessels and often hæmorrhages on it. The tension may be normal or increased, and there may be secondary glaucomatous symptoms. The *treatment*, unless the tumour is very large, is immediate excision of the eye and removal of as much of the optic nerve as possible.

VITREOUS OPACITIES are usually due to inflammation (*hyalitis*) associated with diseases of the uveal tract or retina, but often occur in extreme myopia, and from retinal and choroidal hæmorrhages. The opacities may be of different shapes and sizes, and in syphilis are very minute and dust-like. The patient complains of seeing black specks floating about, and vision is sometimes reduced. Owing to degeneration the vitreous may be fluid, and contain cholesterin crystals.

SUPPURATION OF THE VITREOUS (*suppurative hyalitis*) is due to injury or to extension of a purulent uveitis, and is sometimes called *pseudo-glioma*, from its yellowish fundus-reflex. *Foreign bodies*, as steel, glass, &c., may be found in the vitreous, and *cysticercus* is occasionally located there. An opaque cord, sometimes containing blood, running from the retinal artery forward, may be a *persistent hyaloid artery*, but it must not be mistaken for new vessels passing to opacities in the vitreous.

VII. Glaucoma.—Glaucoma is a condition of the eye dependent on excess of the intra-ocular pressure. The chief *symptoms* are increased intra-ocular tension (elicited by palpating the eyeball with both index fingers through the closed lids); pain and tenderness; enlargement of the large perforating arteries; impaired sensibility, steaminess, and pitted appearance of the cornea; shallow anterior chamber; dilatation of the pupil; greenish fundus reflex; pulsation of the retinal arteries, and engorgement of the retinal veins; undermining and cupping of the optic disk; diminished acuity of vision and light sense; and limitation of field of vision chiefly at nasal side. These symptoms are generally preceded or accompanied by smoky vision (everything seen in a grey or yellow fog), coloured concentric rings round lights, neuralgia along the branches of the fifth nerve, and rapidly increasing presbyopia necessitating frequent changes of glasses.

Varieties.—Glaucoma may be divided into (1) acute, (2) subacute, and (3) chronic.

1. *Acute glaucoma* is characterized by the severity and acuteness of its onset, the prodromata, viz., vomiting, megrim, &c., simulating a bilious attack, being often severe. The steaminess of the cornea prevents as a rule any view being obtained of the fundus although the pupil is widely dilated. The optic disk when seen is found in first attacks not to be cupped, but there is marked pulsation of the retinal arteries and engorgement of the veins. Such an attack may pass off after a few days, but is generally followed by others until the eye passes into a permanent glaucomatous condition (*absolute glaucoma*) and vision is totally destroyed. Absolute glaucoma is accompanied by great pain and increased tension, intra-ocular hæmorrhages, opacity of the lens, ulceration and staphyloma of the cornea, and shrinking of the whole globe. Some cases of acute glaucoma may be accompanied by severe intra-ocular hæmorrhage (*hæmorrhagic glaucoma*).

2. *Subacute glaucoma* is characterized by the symptoms of glaucoma as given above. There is generally a gradual progress, sometimes with exacerbations, and it may at any time give rise to acute glaucoma.

3. *Chronic glaucoma* may follow on an acute or subacute attack, but there is an insidious and progressive form usually attacking both eyes, in which all irritative signs are absent. Without pain and often with no

apparent increase of tension, there is gradual reduction of the amplitude of accommodation, diminished corneal sensibility, and cupping and progressive atrophy of the optic disks often passing on to absolute blindness.

Pathology.—Glaucoma is produced by any circumstance tending to upset the normal relation of the secretion and excretion of the intra-ocular fluids, which, secreted by the ciliary processes, pass chiefly out at the angle between the iris and the cornea (*iridic or filtration angle*). This may be produced by hypersecretion of the ciliary processes, obstruction at the filtration angle, or by serosity of the fluids. The most frequent cause is obstruction at the filtration angle due to inflammatory products, or to mechanical means, as growth of the lens, or dilatation of the pupil. Glaucoma occurs as a rule in persons over 40 years of age, is frequently hereditary, and is often associated with hypermetropia. It may be *secondary* to complete posterior synechia, perforating ulcers and wounds of the cornea, dislocation of the lens laterally and into the anterior chamber, cataract operations, intraocular tumours, and intraocular hæmorrhage.

The *treatment* in *acute glaucoma* is by instillation of eserine (especially if caused by atropine), or by a large iridectomy, as much as one-fifth of the iris being removed. Several other operations have been recommended, as sclerotomy, &c. In *glaucoma absolutum* puncture of the sclerotic often relieves the pain. In *subacute* cases iridectomy is generally indicated, but in *chronic glaucoma* without tension no operative procedure probably does any good.

VIII. DISEASES OF THE ORBIT. — SUBCONJUNCTIVAL HÆMORRHAGE, due to a blow on the eye or to rupture of a small vessel, owing to cough, &c., is of a bright red colour and is more marked towards the front and does not pass far back. Exactly the converse applies to deep orbital hæmorrhage following fracture of the anterior fossa of the skull, &c.

ORBITAL ABSCESS AND ORBITAL CELLULITIS, when acute, are difficult to diagnose from each other. Though often traumatic they may be due to cold, irritation of a tooth, erysipelas, pyæmia, &c. They sometimes originate in periostitis. They are usually characterized by swelling of the lids, chemosis of the conjunctiva, pain on movements of the eye and on pressing back the eyeball, limitation of the ocular movements, facial neuralgia, and proptosis; sometimes there is a defined, tender, fluctuating swelling. If the symptoms are not soon relieved, especially in orbital cellulitis, papillitis and atrophy of the optic nerve may ensue, and also meningitis. Orbital abscess may be chronic and simulate a solid tumour. The treatment consists in early evacuation of the pus, hot fomentations and constitutional remedies.

TUMOURS OF THE ORBIT usually cause protrusion of the eye (*proptosis*), impairment of its movements, and papillitis or optic atrophy. Generally one orbit only is affected. The origin of an orbital tumour may be primary, as in the lachrymal gland, in the loose orbital tissues, in the periosteum, in the eyeball or in the optic nerve; or secondary, starting from a neighbouring cavity. Tho primary tumours may be cystic (hydatid, dermoid), osseous (generally ivory), sarcomatous, and vascular (nævi). Amongst the secondary tumours may be mentioned arterio-venous communication in the cavernous sinus, giving rise to a pulsating tumour, and distension of the frontal sinus by retained mucus (*frontal mucocele*). The *treatment* is chiefly the same as in other parts. Malignant tumours should be removed early along with the eyeball and even the contents of the orbit, and chloride of zinc paste in some cases applied a few days afterwards.

ENUCLEATION OF THE EYE.—Patient lying down and as a rule under general anæsthesia; operator standing behind the head; spring speculum in lids. Divide conjunctiva all round the cornea with scissors; raise each rectus tendon in succession on a squint hook (Fig. 170) and divide them close to the globe; now separate the limbs of the speculum and the eyeball will project forwards; pass a pair of stout curved scissors, closed, behind the globe from the outer side, and feel for the optic nerve, then pull back the scissors slightly, open them, and divide the nerve. The globe, now pushed forwards by the scissors, is taken between the finger and thumb, and the other attachments are divided by the scissors. After the operation firm pressure is applied by a bandage. There is but rarely any trouble from hæmorrhage. An artificial eye may be given about three months after operation, if the socket is healthy.

IX. ERRORS OF REFRACTION AND ACCOMMODATION.—The light-percipient portion of the eye exists at the external layer of the retina (*rods and cones*), and it is necessary for perfect vision that images of external objects should be accurately focussed on this layer. Rays of light passing into the eye are refracted at the anterior surfaces of the cornea, lens and vitreous, and brought to a focus at a point varying with the refraction. The human eye for the sake of simplicity may be represented by a convex lens of 23 mm. focus; and the following laws regulating the passage of light through a convex lens will then be applicable to it. Rays of light passing through a convex lens parallel to the principal axis, and therefore coming from infinity, are brought to a focus at a point (*principal focus*) varying inversely in distance to the convexity of the lens; rays coming from a point closer than infinity (*divergent rays*) are refracted further back from the lens than the focal point; and rays coming from a point beyond infinity (*convergent*) are focussed between the lens and its principal focus.

Emmetropia.—In an eye of normal refraction (*emmetropia*) with its accommodation relaxed, parallel rays passing through the pupil will be focussed by the surfaces at a point represented by the external surfaces of the rod and cone layer of the retina; divergent rays will be focussed behind the retina; and convergent rays in front. In order to focus the divergent rays upon the retina it is necessary to increase the convexity of the lens and so shorten its focal length. This is done by accommodation, and a young emmetrope with normal accommodation should be able to focus on his retina all rays from parallel to divergent ones starting from about 8 inches from his cornea.

Hypermetropia is the condition when the retina only receives convergent rays; parallel and divergent rays are refracted beyond the retina. This takes place from too short a distance between the cornea and the retina, or from lessened convexity of the lens; the usual cause is congenital shortness of the axis of the eye. Hypermetropes from this fact are obliged to accommodate for parallel rays and still more for divergent ones. The *treatment* naturally is to increase the convexity of the lens artificially by giving a convex lens; and by so doing allowing parallel rays to be refracted on the retina, and then the ciliary muscle will be able to focus divergent rays on the retina. In children and young adults to find out their hypermetropia it is often necessary to order atropine before testing the refraction. The *symptoms* of hypermetropia are pain and discomfort on reading, congested eyelids and conjunctivæ, spasm and fibrillar twitchings of the lids, convergent strabismus, headache, &c.

Hypermetropia is usually congenital, often hereditary, and is associated with a flat-looking face, shallow orbits and small eyes.

MYOPIA is the opposite condition to hypermetropia, and in it the retina only receives divergent rays. It is due as a rule to the axis of the eye being too long, or in some cases to the ciliary muscle rendering the lens too convex (*spasm of accommodation*). The *treatment*, except in cases of spasm of accommodation, is to give concave glasses to allow parallel and other divergent rays to fall on the retina. In low degrees of myopia it is only necessary to order glasses for distance, but in high degrees it is usual to order a stronger pair for distance, and a weaker pair for reading, &c. In apparent myopia due to spasm of the ciliary muscle it is necessary to order atropine to find out the true refraction. Myopes often have the head elongated in the antero-posterior diameter, a long face and large prominent eyes. Myopia is generally accompanied by a crescent at the outer side of the disk (*posterior staphyloma*), and there may be secondary choroidal trouble, detachments of the retina, vitreous opacities, &c.

ASTIGMATISM is the condition in which one or more of the refractive surfaces have not the same curvature in all directions. Astigmatism may be divided into—(1) *irregular*, in which there is a difference of refraction in the different parts of the same meridian due to changes in the lens and cornea; and (2), *regular* where there is a difference in two meridians (*chief meridians*) at right angles to one another, and called those of maximum and minimum refraction. It is usually corneal (*static astigmatism*), but may be due to the ciliary muscle (*dynamic astigmatism*). Regular astigmatism may be—(*a*) *simple*, where one meridian is emmetropic and the other hypermetropic or myopic, and is then called simple hypermetropic or myopic astigmatism; (*b*) *compound*, where the meridians are unequally myopic (compound myopic astigmatism) or unequally hypermetropic (compound hypermetropic astigmatism); or (*c*) *mixed*, where one meridian is hypermetropic and the other myopic.

The *treatment* is by cylindrical glasses alone for simple astigmatism, and cylindrical glasses in combination with sphericals, for compound and mixed.

PRESBYOPIA.—From 40 to 45 years of age it is found in all eyes, owing to changes in the elasticity of the lens, that the ciliary muscle begins perceptibly to lose its power of altering the convexity of the lens. The effect of this will be to prevent near objects being focussed on the retina, and to counteract this condition and help the ciliary muscle it is necessary to give convex glasses for reading. It has been found that the glass necessary is about one dioptre for every five years after 40. In myopes wearing glasses for reading, this amount will have to be subtracted from their glasses.

X. STRABISMUS AND OCULAR PARALYSIS.—STRABISMUS (*squint*) is always present when the two eyes are not directed simultaneously towards the same object, and is usually accompanied at some time by double vision (*diplopia*). Strabismus occurs from over-action, weakness, or paralysis of one or more of the extrinsic ocular muscles. It is usually convergent or divergent, but may be upward or downward. It may be constant or occasional (*periodic*), and though usually one eye alone squints, yet sometimes both eyes may do so in turn (*alternating*). When the squinting eye follows its fellow normally in all its movements the squint is called *concomitant* in contra-distinction to *paralytic*. Diplopia is much more marked in paralytic than in concomitant squint. The non-squinting eye is called the *fixing* eye, and strabismus may be estimated by telling the patient to look at an object about two feet away with the fixing eye, and then taking the distance between the middle of the palpebral aperture and the middle of the cornea of the squinting eye (*primary squint*); on now making the squinting become the fixing eye the amount of deviation of the original fixing eye is taken (*secondary squint*). In *paralytic* cases the secondary squint exceeds the primary, but it is equal to the primary in *concomitant* squint.

Convergent (internal) *squint* is most commonly due to hypermetropia, owing to the fact that the excessive accommodation necessitates a corresponding convergence; but it may occur occasionally in myopia, and may follow division or paralysis of an external rectus.

Divergent (external) *strabismus* follows from insufficiency of convergence power, and weakness of the internal recti, especially in myopia; from defective vision of an eye, as in corneal nebulæ, &c.; and from division or paralysis of an internal rectus.

The *treatment* of strabismus is by constitutional remedies, atropine, eserine, spectacles, prisms, and stereoscopic exercises. The operations that may be required are either tenotomy of the muscle of the affected side, or advancement of the muscle of the opposite side.

Tenotomy of the internal rectus.—Patient lying down and under cocaine or general anæsthesia; operator standing in front and to the right-hand side. Introduce the spring speculum, and pinch up with a pair of fixation forceps the conjunctiva and subconjunctival tissue at the point of junction of the lower horizontal and inner vertical tangents to the cornea. Divide this fold with a pair of blunt-pointed scissors, making the incision only large enough to admit the points of the scissors, and then, passing the scissors through the incision, divide the capsule of Tenon. Pass the strabismus hook (Fig. 170) into the wound, directing its point backwards, and then turn the end of the hook upwards between the globe and the tendon, until its point is seen beneath the conjunctiva, at the upper border of the tendon. Introduce the scissors through the wound and open the blades on either side of the tendon, between the globe and the hook, and by one or two snips cut through the tendon. Remove the hook and then reintroduce it to see if the tendon is completely divided.

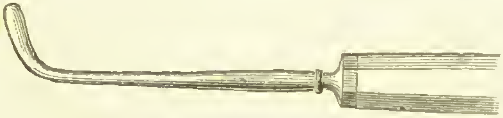


FIG. 170.—Strabismus hook.

The method is the same for the external rectus, but it must be remembered that the tendon is situated a little further back.

OCULAR PARALYSIS.—*Complete Paralysis of the Third Nerve* is characterized by complete ptosis; external strabismus; inability to move the eye directly up, down or in; crossed diplopia; mydriasis and inactivity of the pupil to all the reflexes; and paralysis of accommodation. Any one of the muscles supplied by the third nerve may be separately paralysed, also the superior oblique (fourth nerve) and the external rectus (sixth nerve). *Paralysis of the external rectus* gives rise to internal strabismus, inability to move the eye outwards, and homonymous diplopia. It is the most common of the ocular palsies, probably from the long course of the sixth nerve. All the external ocular muscles may be paralysed at the same time (*ophthalmoplegia externa*).

The intra-ocular muscles are the pupillary (*sphincter pupillæ*) and the ciliary. The *pupillary* muscle may be affected by paralysis of the third or short ciliary nerves, producing medium mydriasis, and by paralysis of the cervical sympathetic or long ciliary nerves, producing partial miosis. The *ciliary* muscle may be paralysed (*cycloplegia*) by affections of the third or short ciliary nerves, usually in conjunction with paralysis of the pupillary muscle, but it may be paralysed alone as in diphtheria.

In certain diseases, especially locomotor ataxia, a condition called the Argyll-Robertson or spinal pupil is observed, where the pupil acts to accommodation but not to light. In a few cases complete palsy of all the external and internal ocular muscles has been observed.

The *treatment* of ocular paralysis is chiefly constitutional, as many are of syphilitic origin, but faradisation of the affected muscle may also be employed. In mydriasis and cycloplegia, the use of eserine is indicated.

Nystagmus (*involuntary oscillations of the eyeball*) is generally binocular, and the movements of the eyes are usually horizontal or rotatory. It occurs generally in early life, and is then due to defect of sight from corneal ulcer, &c., sometimes in adult life, in cases of disseminated sclerosis, &c., and in miners, in whom it is probably due to their position at work.

DISEASES OF THE LIPS, CHEEKS, AND MOUTH.

1 Herpes of the lip.—A crop of herpetic vesicles which burst in a few days leaving small scabs, are common on the lip during slight attacks of catarrh, indigestion, &c. Their occurrence in pneumonia is well known.

2 Cracks and fissures of the lip following exposure to cold, &c., in dyspeptics, are very common, and if neglected, may form deep and painful fissures, prone to bleed and obstinate to heal. A simple ointment, and if persistent, touching them with nitrate of silver, will generally suffice to cure them. They must not be mistaken for the fissures about the corners of the mouth so common in congenital syphilis.

3 Papillomata or warty growths of the lip are of interest in that they are liable as age advances to become

epitheliomatous. They may sometimes grow out in the form of horns. Extirpation with the knife is the only treatment.

4 SUPERFICIAL ULCERS on the inner surface of the lip are common accompaniments of errors in digestion, and of secondary syphilis. There are usually similar ulcers on the side of the tongue and cheeks. Nitrate of silver or chromic acid lotions are the best local applications.

5 NÆVUS OF THE LIP when small may be touched with nitric acid or ethylate of sodium; and when pendulous and projecting from the free margin, ligatured. When involving the whole substance of the lip it may be treated by electrolysis, or, better, excised by means of a V-shaped incision.

6 HYPERTROPHY OF THE LIP, generally the upper, is often met with in connection with cracks and fissures in strumous children, and is known as the *strumous lip*. A similar condition is sometimes met with in congenital syphilis and in chronic nasal catarrh. The thickening, as a rule, disappears under constitutional treatment and as the patient grows older. The removal of a wedge-shaped piece, as advised by some, can seldom be necessary.

CARBUNCLE OF THE LIP is a most dangerous disease, as it is very liable to lead to infective phlebitis of the facial vein which may spread thence through the ophthalmic vein to the cavernous and other cranial sinuses, and terminate in infective meningitis or in general blood poisoning. Free incisions should be made, antiseptics applied, and the strength supported by fluid nourishment and stimulants.

ADENOMATA, OR LABIAL GLANDULAR TUMOURS (Paget), occasionally occur in the lip as small, smooth, elastic growths projecting under the mucous membrane. They sometimes contain nodules of cartilage, and are then of harder consistency. They should be removed from the mucous surface to avoid scarring.

CYSTS due to obstruction of the mucous follicles are frequent in the lip. They contain a glairy fluid, and appear as small, tense, semi-translucent, globular, bluish-pink swellings on the mucous surface. A free incision through the mucous membrane, and removal of the cyst-wall with forceps, is perhaps the best treatment.

10 EPITHELIOMA nearly always occurs in men, and on the lower lip; and although it may affect non-smokers, it generally appears to be due to the irritation and heat of a

short clay pipe. It begins as a crack, small ulcer, or indurated tubercle, and may either spread superficially along the free margin of the lip, or extend deeply into its substance. Sooner or later it involves the whole lip and adjoining parts, becomes adherent to the jaw, and invades the bone. The lymphatic glands in the neck become involved, but dissemination through internal organs is rare. If removed early, it may not recur till after a long period of immunity, or perhaps not at all. It seldom returns in the scar, but in the lymphatic glands, the patient dying of exhaustion induced by ulcerating and bleeding masses in the neck. The affection is very apt to be mistaken for *hard chancre*, and the latter has ere now been cut away under the impression that it was an epithelioma. The following points should serve to distinguish them :—1. Epithelioma generally occurs in the old, and in men, and on the lower lip; chancre in the young, in women, and on the upper lip. 2. The epitheliomatous ulcer has hard, sinuous, and everted edges, and an indurated and warty base; the chancrous is raised, excoriated, smoother, and the induration is more circumscribed. 3. In the malignant affection, the glands are not affected till late in the disease—perhaps six months; in the syphilitic early, say six weeks. Moreover, in chancre secondary symptoms will be present or soon appear, and the disease readily yields to antisyphilitic remedies. *Treatment.*—Free and early excision is imperative. The growth may be either included in a V-shaped incision, the wound being afterwards united by hare-lip pins, or if superficial, freely shaved off. The glands in the neck, if enlarged and not too extensively diseased, should be extirpated at the same time. When the bone is involved, a portion of the jaw may be removed if the whole disease can be got away.

HARE-LIP is a congenital malformation in which the upper lip is vertically cleft on one or both sides of the median line. It is so named from its fancied resemblance to the lip of the hare. It is produced by the failure of union of the fronto-nasal process which forms the median portion of the lip with the superior maxillary processes which form the lateral portions. The fissure will, therefore, be opposite the suture between the superior maxillary and premaxillary bones, the situation at which the union between the above-mentioned processes normally occurs; and it will be single or double, according as the failure of union occurs on one or both sides. It may exist as a mere notch on the free margin of the lip, but it more frequently extends deeply through the substance of the lip into the nostril above. Single hare-lip is far more common than double hare-lip, and occurs much more often on the left than on the right side. The two margins of the cleft are often unequal in length, the lip on one side of the cleft being on a lower level than on the other. In double hare-lip the central portion is generally shorter than natural, and along with the premaxillary bone and the incisor teeth frequently projects forwards, the two clefts being often of unequal extent. Cleft palate is a frequent concomitant of hare-lip, and malformations, such as club-foot, spina bifida, &c., are not uncommon in other parts of the body at the same time.

Treatment.—The edges of the cleft should be pared, and the raw surfaces brought into contact, and there held by hare-lip pins or sutures, so that primary union may occur. The operation is best done between the third and fifth months of infancy, as very young infants bear hæmorrhage badly, and later, the troubles of teething begin. To ensure success the child should be brought into the best possible state of health by careful nursing and feeding, and any constitutional taint, as syphilis, corrected by appropriate remedies.

There are various methods of operating. Here only the more simple can be described. Whatever method is adopted, the objects to be kept in view are—1, to obtain primary union throughout the wound, and hence the minimum of scarring; 2, to ensure the margin of the prolabium and free border of the lip respectively being in line; 3, to prevent the formation after the operation of a notch at the line of union. These objects are best attained by well freeing the lip from the gums at the apex of the cleft so as to avoid tension; by using a sharp knife so as to ensure clean incisions; by taking care to completely pare the margins of the cleft, and to remove sufficient tissue to procure broad, raw surfaces; by passing the hare-lip pins on the same level, and deeply enough to bring the whole of the raw surfaces into contact; and by making the cuts in paring the edges concave towards the middle line of the cleft, so as to lengthen the line of union and allow for retraction.

Operation for single hare-lip.—Having placed a Smith's clamp (Fig. 171) on the lip on either side of the cleft to control hæmorrhage, pare the edges of the cleft with a sharp narrow-bladed scalpel, taking care to remove the whole of the rounded portion of the prolabium on each side of the base of the cleft; and having freed the lip from the gums at the apex of the cleft, bring the raw surfaces together by hare-lip pins, passing the lower one first, to ensure the free edge of the lip and prolabium being in line. The lower pin should be entered a quarter of an inch from the margin of the cleft, and made to transfix the coronary artery; but it should not penetrate the mucous membrane, as if this be done the mucous membrane will double in and prevent union. A second pin will generally be necessary, and should be passed in the same way, and a silk suture twisted round each. The sharp ends of the pins should be nipped off with pliers, a small piece of oiled lint placed beneath them to prevent injury to the cheek, and several sutures of horsehair passed superficially to keep the edges of the wound in accurate apposition. The parts should then be dried, and covered with collodion, and a dumb-bell-shaped piece of strapping applied across from cheek to cheek to prevent traction. The pins should be removed at the end of twenty-four to thirty-six hours, as otherwise they will leave scars. The twisted suture should be left on till firm union has occurred, and the strapping

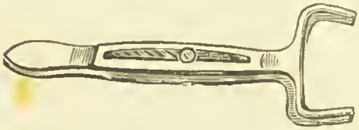
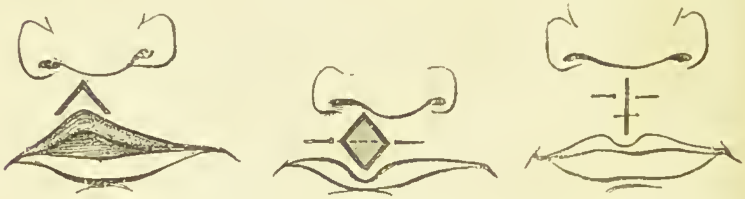


Fig. 171.—Smith's clamp for controlling hæmorrhage during operation for hare-lip.

Fig. 172. Fig. 173. Fig. 174.



Figs. 172, 173, 174.—Operation for single hare-lip when the fissure does not extend into the nostril.

re-applied. Where the fissure does not extend through the whole lip, an inverted V-shaped incision may be made, with its angle just above the apex of the cleft (Fig. 172), each arm stopping short of the prolabium; the tissues included in the arms of the V should now be drawn down, and a diamond-shaped wound thus formed (Fig. 173). On bringing the raw surfaces together, a projection in place of the fissure will exist on the free border of the lip (Fig. 174); but this will disappear in time, leaving the lip nearly natural. When there is much irregularity between the two portions of the lip (see Fig. 175), the incision on the shallower side should stop short of the prolabium, so as to allow the flap thus formed to remain attached at its base. On the deeper side the incision should slope off at an angle through the prolabium, completely removing the tissue. The flap left on the shallower side should be now turned down and united to the sloped-off portion on the deeper side, and the vertical portions of the incision brought together as usual.

Fig. 175.

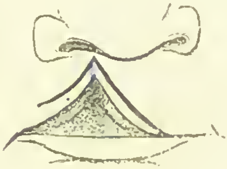
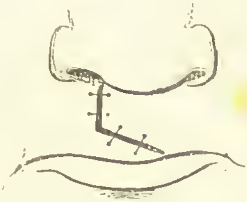


Fig. 176.



Figs. 175, 176.—Operation for single hare-lip when the sides of the fissure are unequal.

Fig. 177.

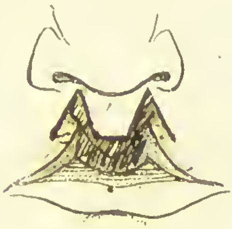
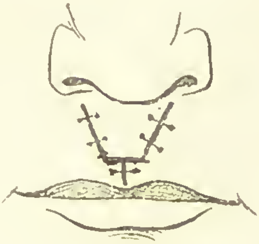


Fig. 178.



Figs. 177, 178.—Operation for double hare-lip.

Thus, what was the free edge of the cleft on the shallower side, now becomes the free edge of the lip (Fig. 176).

Operation for double hare-lip.—When the premaxillary process projects, it should not, as a rule, be removed, but be forced back into place by partially detaching it with the cutting pliers blunted by being wrapped in lint, and the lip united over it. There are many ways of uniting the lip. The simplest, perhaps (Fig. 177 and 178), consists in paring completely the central portion, and then making two flaps from the lateral portions, bringing them down and uniting them to each other below the central portion, and also to it, so that they may fill up the gap left by the deficient length of the central portion.

12/ RODENT ULCER perhaps most often occurs on the cheek, especially near the outer and inner canthus of the eyelids, the ala of the nose, and the external auditory meatus; and is therefore conveniently described here. It is also met with on the scalp. Rodent ulcer is generally regarded as a form of carcinoma; it differs from ordinary carcinoma, however, in that it is much slower in its growth, and does not become disseminated, affect the lymphatics, or return after removal. *Signs.*—The disease is one of advanced life, and seldom occurs before fifty. It generally begins as a wart, which later becomes an ulcer; the ulcer is generally single, its edges are irregular, sinuous, and a little raised, and but very slightly if at all indurated; its base is slightly depressed, void of granulations, generally of a pale pink colour, and at times covered with a scab. The skin around is healthy, and although attempts at cicatrization are sometimes seen, the ulcer never quite heals, but slowly extends, destroying muscle, cartilage, and bone, and ultimately produces great deformity. *Treatment.*—It should be early and widely extirpated with the knife; or if any part cannot be thus removed, what remains should be destroyed by caustic or the cautery.

STOMATITIS, or inflammation of the mouth, may be divided into the aphthous, the parasitic, the ulcerative, the syphilitic, the mercurial, and the gangrenous.

Aphthous stomatitis generally depends upon some digestive disturbance, and is common in young children. It is characterized by white patches of erosion on the mucous membrane of the lips, cheek and tongue. Rhubarb and magnesia, and locally borax and honey, are the usual remedies.

Parasitic stomatitis or thrush, resembles the preceding, but depends upon the presence of a parasite known as the *oidium albicans.* It is generally merely symptomatic of other diseases, to the alleviation and cure of which the treatment should be directed.

Ulcerative stomatitis is more serious, but is still, as a rule, superficial. It may depend upon digestive disturbance, local irritation of cutting teeth, or bad hygiene. The ulcers are covered with a grey slough, the gums are red and swollen, and the breath is foul. A stimulating plan of treatment is generally required, with attention to the digestive functions, hygienic surroundings, &c. Locally, the mouth should be rinsed out with a wash of chlorate of potash.

Syphilitic stomatitis is common during the secondary and tertiary stages of syphilis, and requires no further mention.

Mercurial stomatitis, depending upon an overdose of mercury, or some idiosyncrasy of the patient to the drug, is of less frequent occurrence in its severe forms than formerly. It is attended with foul breath, swollen tongue, spongy gums, profuse salivation, swelling of the parotid and submaxillary glands, and loosening of the teeth. It may terminate in gangrenous ulceration, with extensive destruction of the soft tissues, and perhaps necrosis of the bones. Chlorate of potash, both internally and as a mouth-wash, should be given; and the strength supported by fluid nourishment, and if indicated, by stimulants.

Gangrenous stomatitis or *cancrum oris*, is a phagedænic ulceration, which begins on the inside of the cheek and if not checked rapidly involves its whole thickness. It is very apt to terminate in blood-poisoning. It appears to depend upon thrombosis of the capillaries, a condition recently shown to be induced by the presence of a specific micro-organism. It is most frequently met with in underfed, debilitated children recovering from one of the exanthemata, typhoid fever, &c., or subjected to bad hygienic conditions. A foul and black slough forms in the mouth and a dusky patch soon appears on the surface of the cheek, which becomes hard and brawny, and then black; and if the disease is not soon arrested, extensive sloughing occurs, typhoid symptoms set in, and the patient dies comatose, of general blood-poisoning, or of bronchitis or pneumonia. It appears to be of a nature similar to the gangrenous inflammation of the female genitals known as noma. The *treatment* must be energetic. The parts should be well dried, and thoroughly destroyed with fuming nitric acid; or boroglyceride may be applied in milder cases. The strength must be supported with strong beef-tea, brandy-and-egg mixture and nutrient enemata ; and recumbency should be insisted upon during convalescence, as there is a tendency to fatal syncope, which may remain for some time.

SALIVARY CALCULI are sometimes met with blocking the orifice of Wharton's duct, or, more rarely, one of the ducts of the other salivary glands. They are composed of animal matter, impregnated with phosphate and a trace of carbonate of lime. Generally they can be seen, or at any rate felt, in the interior of the mouth, as hard bodies in the course of the duct. They may give rise, by causing retention of the secretion of the gland, to swelling, pain, and tenderness in the obstructed gland, and sometimes to suppuration and salivary fistula. An incision through the mucous membrane over the calculus will allow of its removal with a scoop or forceps. Should stricture of the duct follow it must be divided transversely.

RANULA is a bluish-white, semi-translucent, globular or ovoid swelling situated in the floor of the mouth beneath the tongue, and containing a glairy mucoid fluid. It is probably produced by the enlargement of one of the mucous follicles so numerous in that situation. Mr. Morrant Baker has conclusively shown that it is not usually a dilatation of Wharton's duct, as was formerly taught. It is painless, but interferes to a greater or less extent, according to its size, with the movements of the tongue in speech and deglutition. Sometimes these cysts attain a large size and extend deeply in the neck, presenting below the jaw. *Treatment.*—After painting the parts with a twenty per cent. solution of cocaine, a portion of the cyst-wall should be pinched up with nibbed forceps, and a good-sized piece of it excised with curved scissors. A deep hold must be taken or the mucous membrane, which adheres but loosely to the cyst, will alone be caught up. The fluid should be squeezed out, and the lining membrane cauterized with a stick of nitrate of silver, and the opening kept free by the daily passage of a probe, so that healing may take place from the bottom. If a mere incision is made, the cyst is nearly sure to fill again. A seton will sometimes answer, but it is not always reliable; if, therefore, the treatment above indicated fails, the cyst should be dissected out.

CONGENITAL, DERMOID, OR DEEP SEBACEOUS CYSTS.—These cysts, which contain a grumous, sebaceous material, project both under the tongue and in the neck below the jaw. Fluctuation may be obtained by one finger in the mouth and another on the cyst in the neck. As they increase in size, they send prolongations in various directions, and are sometimes connected with the hyoid bone, or with the carotid sheath. In the latter instance the pulsation of the carotid may be communicated to the cyst. *Treatment.*—When not too large, and apparently moveable, an attempt should be made to remove them through the mouth to prevent scarring. When too large for this, they must be dissected out through an incision in the neck.

DISEASES OF THE TONGUE.

TONGUE-TIE is due to the tongue being more or less tightly bound down to the floor of the mouth by the shortness of the frænum. It is apt, when well marked, to interfere with sucking, and later, with distinct speech. It is easily remedied by dividing the frænum with probe-pointed scissors, taking care to direct the points downwards and backwards, and merely to notch the free border lest the ranine artery be wounded, an accident which, in infants, has been attended with severe, and in some cases fatal, hæmorrhage. If the division of the frænum is too free the tongue may loll backwards, pressing the epiglottis over the entrance of the larynx, and produce severe dyspnœa or even fatal asphyxia—"swallowing the tongue," as it has been called. On drawing the tongue forwards the symptoms will at once cease; but a ligature should be passed through its tip and secured to the cheek, with instructions to again draw the tongue forwards with the ligature, should the symptoms recur.

NON-DIFFERENTIATION of the tongue from the surrounding tissues gives rise to the rare malformation in which the tongue appears bound down to the floor of the mouth. This condition must not be mistaken for that called *ankyloglossia*, in which the tongue, in consequence of cicatricial adhesions, presents a similar appearance. Divisions of the adhesions in the latter case will do much to remedy the affection.

Macroglossia, or hypertrophy of the tongue may be congenital or acquired. In either case it is rare. The whole tongue is uniformly enlarged, and sometimes so much so that it presses forwards the alveolar process of the lower jaw with the incisor teeth, and protrudes from the mouth, hanging downwards as low as the chin. When thus exposed the mucous membrane becomes cracked, spongy, and bluish-red, and is subject to repeated attacks of subacute glossitis. The affection appears to be due to a blocking of the lymphatics at the base of the tongue; at any rate the lymphatics are found enlarged and distended with lymph, and the connective tissue is increased in amount and infiltrated with lymphoid corpuscles. It appears related, therefore, with elephantiasis—a condition sometimes found co-existing in the neck and other parts of the body. The only treatment of much avail is excision of part of the organ. The removal of a V-shaped piece has been attended with excellent results. It should be done before the teeth and jaw have been deformed by the pressure.

Acute parenchymatous glossitis, or deep inflammation of the tongue, may be due to mercury, fever, iodism, injury, carious teeth, stings of insects, abscess beneath the jaw; sometimes there is no apparent cause. In severe cases the whole tongue is swollen, and protrudes from the mouth, interfering with speech and deglutition, and sometimes threatening suffocation. It frequently ends in abscess. It is often attended with high fever and salivation, and may be quite sudden in its onset. *Treatment.*—Should the milder means applicable to acute inflammations fail, free longitudinal incisions, which need not be deep, should be made along the dorsum of the tongue, and the swelling will usually subside in a few hours.

Suppuration or abscess sometimes follows an attack of acute glossitis; but the preceding inflammation may be so slight as to be overlooked. The abscess, which then forms a firm, tense, elastic swelling in the substance of the tongue, may be mistaken for a gumma or carcinoma; but the diagnosis is readily made by an exploratory puncture. A free incision is the proper treatment, the cavity filling up in a few days.

Chronic superficial glossitis, also known as psoriasis, ichthyosis, or leucoplakia of the tongue, is a chronic inflammation of the mucous membrane, and may be induced by syphilis, excessive smoking, some forms of dyspepsia, the abuse of spirits, jagged teeth, &c. It begins as a hyperæmia of the papillary layer, and presents at this stage slightly-raised red patches better seen if the tongue be dried. This is followed by excessive growth of epithelium, the cells of which assume a horny character, and the patches, which were previously red, become bluish white, and later, opaque white. Several of the patches may now coalesce, covering in severe cases the whole or greater part of the dorsum of the tongue. It is this condition to which the term *psoriasis* has been applied from its superficial resemblance to psoriasis of the skin. Still later, from excessive heaping up of the epithelium, the surface of the organ becomes cracked and nodular, simulating *ichthyosis*, a name by which it has also been called. As the pathology of the affection, however, is distinct from that of the above-named affections of the skin, it would be better to drop these terms, and to call the affection either *leucoplakia* (*white patches*), or *chronic glossitis*. After variable periods, the hypertrophied papillæ may atrophy, or ulceration may occur; or the epithelium may grow into the substance of the tongue and the disease become epitheliomatous. At times the inflammation does not give rise to an increase of epithelium, the tongue then appearing smooth, glazed, and red. The disease, except when ulceration occurs, causes little or no pain, and often gives rise to no inconvenience; but it should always be carefully watched for any sign of its becoming epitheliomatous. A similar condition of the mucous surface of the lips and cheeks is a common accompaniment, especially in smokers (*smokers' patches*). *Treatment.*—All sources of irritation, especially smoking, stimulants and condiments, should be avoided; antisyphilitic remedies given where indicated; and soothing washes of chlorate of potash or borax applied. Should any of the leucoplakial patches show signs of ulceration the whole patch should be at once excised; or should signs of epithelioma already be present the whole or half of the tongue should be removed.

ULCERATION OF THE TONGUE may be simple, tubercular, syphilitic, lupoid, or epitheliomatous. Aphthous ulceration, and that following mercurial salivation, have been described under stomatitis.

Simple ulceration may depend on digestive disturbance (*dyspeptic ulcer*), or on irritation, as of a sharp or carious tooth, hot pipe stem, &c. (*dental or irritable ulcer*). Both varieties are generally superficial, and unattended with the induration and infiltration characteristic of epithelioma.

The *dyspeptic ulcer* usually occurs on the dorsum of the tongue near the tip. The ulceration is sometimes extensive and multiple, and is often accompanied by some superficial glossitis at other parts of the tongue.

The *dental ulcer* is situated on the side of the tongue, and generally corresponds with a carious or sharp tooth. At first it may be a mere superficial red abrasion, but if neglected, it becomes a distinct ulcer, irregular in shape, and surrounded with an inflammatory area. The edges are abrupt and a little raised, but not everted; the base is depressed, sloughing, and sometimes phagedænic, but not indurated unless the ulcer has existed some time, when it may become callous. It is always unattended with infiltration.

Treatment.—In the *dyspeptic ulcer* the diet and bowels must be carefully regulated, bismuth or soda in infusion of calumba given internally, and soothing washes or borax and honey applied locally. Caustics must be avoided. In the *dental ulcer* any offending tooth must be filed, stopped, scraped, or extracted, in short, every source of irritation removed. The ulcer will then rapidly heal, but if neglected it may become epitheliomatous. On the first appearance of infiltration, therefore, free excision is imperative.

Tubercular ulceration of the tongue is rare, and generally occurs in young adult males, the subject of phthisis or of general tuberculosis. It usually begins as a small pimple or nodule on the dorsum of the tongue, especially near the tip. This, after a short time, breaks down into a round, oval, or irregular, painful ulcer. The edges are slightly raised, vertical, inverted, or undermined, sometimes slightly thickened, but never everted or greatly indurated. The base is uneven or nodular, and covered with coarse, pinkish-grey granulations, or with a grey or yellow shreddy slough. Sometimes several smaller ulcers appear around the one first formed, and coalesce with it. The ulceration usually progresses in spite of treatment, the patient dying of lung or other tubercular affection. The absence of glandular enlargement, of induration, and of signs of syphilis, along with the presence of tubercle elsewhere, and the characters given above, should serve to distinguish it from syphilitic and epitheliomatous ulceration.

Treatment has hitherto been of little service. The ulcer, however, may be soothed by Ferrier's snuff or cocaine; or if the constitutional state does not forbid, it may be scraped with a Volkmann's spoon, and dusted with iodoform, cauterized with nitrate of silver, or cut out. The usual constitutional treatment for tubercle should, of course, at the same time be employed.

Syphilitic ulceration may be divided for practical purposes into the superficial and deep; the former commonly occurring in the early, the latter in the later stages of syphilis.

(*a*) *The superficial ulcers* affect the side of the tongue, and are frequently associated with similar ulcers on the lips, cheeks, palate, gums, and fauces. They are usually of an oval or irregular shape and have sharply cut edges, an ash-grey base, and a surrounding areola of inflammation. They readily disappear under the influence of mercury, and the local application of a lotion of nitrate of silver or chromic acid. These ulcers are sometimes associated with a heaping-up of epithelium similar to that which occurs in mucous tubercles.

(*b*) *The deep ulcers* are due to the breaking down of syphilitic gummata. They generally occur in the centre of the dorsum of the tongue as deep, irregular excavations, with raised, slightly concave or undermined edges, and a base covered with a yellow slough and *débris* of breaking-down tissue. They are usually surrounded with a red areola. On healing, they leave characteristic, cracked, or stellate-looking scars. Their situation at or near the middle of the tongue, the absence of induration and of glandular enlargement, the history of the previous gummatous swellings and of syphilis, and their amenability to anti-syphilitic remedies, should serve to distinguish them from epithelioma or other forms of carcinoma. *Treatment.*—Large doses of iodide of potassium, combined with quinine if the constitution is at all broken, and the local application of a cleansing gargle, as chlorate of potash, will rapidly cause them to heal. The scars left by these ulcers sometimes, though rarely, degenerate into epithelioma. Should any induration therefore appear in them, their free removal with the knife should at once be undertaken.

Lupoid ulceration of the tongue is very rare. I have only seen one case during an experience of twenty years at St. Bartholomew's Hospital. This was under the care of my colleague, Mr. Butlin. The case occurred in a young girl with very extensive lupus about the nose, lips, and mouth. Scraping with a Volkmann's spoon was the treatment adopted.

Epitheliomatous ulceration is due to the breaking down of an epithelioma. It is described under ulceration instead of amongst new growths, as in consequence of the irritation from the teeth, food, and the movements of the tongue, epithelioma in this situation very rapidly ulcerates, even if it does not begin as an ulcer: hence it is from other ulcers rather than from new growths that it has to be distinguished. It is much more common in men than in women, and seldom occurs under the age of forty. Often it is due to the irritation of a carious or sharp tooth, and then begins as a dental ulcer; or it may arise in the scar left by a syphilitic ulcer, or follow upon the condition of the tongue known as chronic superficial glossitis. Occasionally it begins as a wart or pimple in patients in whom no cause for it can be assigned. It is most common on the side of the tongue opposite the molar or bicuspid teeth. The ulcer is irregular, with raised, sinuous, hard and everted edges, and an uneven, excavated, or warty base; while the tissues around are infiltrated and indurated. Its growth is generally rapid, and attended with neuralgic pain and copious salivation. If allowed to take its course it spreads backwards to the pillars of the fauces, downwards to the floor of the mouth, and inwards to the opposite half of the tongue; whilst the submaxillary lymphatic glands, and later the lymphatic glands in the neck become enlarged, and the parts about the angle of the jaw infiltrated and matted together by the disease. Secondary ulcers then form from the breaking down of the glands in the neck, and the patient dies, worn out by pain and irritation, or exhausted by hæmorrhage; but like epithelioma in other parts it seldom becomes disseminated in distant organs. *Treatment.*—Early and free extirpation ought in every instance to be undertaken. But when the disease has attained some magnitude, the propriety of removal becomes a question, and opinions differ under what circumstances it ought to be attempted. Its removal is contra-indicated:—1, when it has extended so far backwards that the finger cannot reach healthy tissue beyond it; 2, when it is firmly and extensively adherent to the jaw; 3, when the tongue is firmly bound down to the floor of the mouth; 4, when the glands not only below the jaw, but deep in the neck, are much implicated; and 5, when the patient is too weak or enfeebled by age, or emaciated from the disease itself, or from disease of other organs, to stand an operation. Moderate enlargement of the glands, slight adhesion to the jaw, and some infiltration of the floor of the mouth, do not, in my opinion, forbid an operation (especially if the patient is suffering from much pain, and is otherwise in good health), provided the whole of the affected parts can be got away. Where the disease is regarded as beyond the reach of extirpation, the pain and salivation may often be relieved by stretching or dividing the gustatory nerve. This can readily be done by making a small incision transversely from the last molar tooth through the mucous membrane to the side of the tongue, then passing an aneurism needle into the wound, and hooking up the nerve, which is here quite superficial. Cocaine, or morphia and glycerine, may be painted on the part, whilst the patient's remaining span of life may be rendered bearable by increasing doses of opium or morphia.

TUMOURS OF THE TONGUE.—*Papillomatous or warty growths* are not uncommon, and may be distinguished from epithelioma, into which they are liable to degenerate as age advances, by the absence of induration about their base. They should be freely removed by the knife or scissors. *Vascular tumours* or *nævi* are occasionally met with, and may be destroyed by the galvano-cautery, or removed by the ligature or knife. *Fibrous, fatty, myxomatous, sarcomatous,* and *carcinomatous tumours* other than the epithelial variety, which has already been described under epitheliomatous ulceration, are too rare in the tongue to call for further remark. For *mucous tubercles* and *gummata* see Syphilis of the Tongue.

SYPHILIS OF THE TONGUE may occur as: 1. Primary chancre. 2. Mucous tubercles. 3. Superficial glossitis. 4. Superficial and deep ulceration; and 5. Gummata. *Primary chancres*, which are very rare in this situation, require no description. *Mucous tubercles* consist, as elsewhere, of heapings up of epithelium over infiltrated and enlarged papillæ, and appear as flattened elevations of a greyish-white colour. They are generally present on the palate and fauces at the same time. Mercury internally, and black wash locally, cause them rapidly to disappear. *Superficial glossitis* and the *superficial* and *deep ulcerations* have already been described. *Gummata* occur as hard, globular masses in the fibrous tissue of the septum, and also in the substance of the muscle. They may be single or multiple. The mucous membrane covering them is at first natural in appearance, but, as the gumma softens, it gives way, and a deep syphilitic ulcer is produced. Iodide of potassium is the remedy.

Excision of the tongue may be performed in many ways. Only those methods in most general use will be here described. They will be considered under the heads of, excision with (1) the knife, (2) the écraseur, (3) the scissors, (4) the galvano-cautery.

1. *Excision with the knife*, on account of the profuse hæmorrhage which attends it, is only applicable when the anterior portion of the tongue requires removal. The tongue should be well drawn forward and the diseased portion cut away with one sweep of the knife, and the bleeding vessels tied.

2. *The écraseur* is frequently used at St. Bartholomew's. The mouth having been widely opened by a gag, two ligatures are passed through the tongue, one on either side of the tip, and the mucous membrane, where it is reflected from the tongue to the jaw, is divided with scissors along with some of the fibres of the genio-hyo-glossus. The mucous membrane covering the dorsum of the tongue is

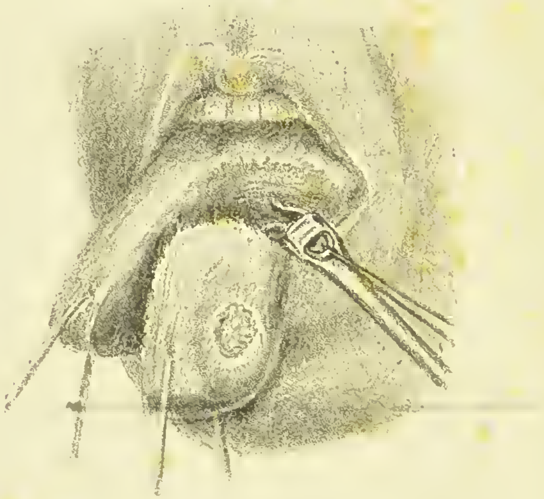


Fig. 179.—Excision of the tongue with the écraseur.

next divided in the middle line by a bistoury from the tip as far back as to be well beyond the disease. This allows the tongue to be readily split with the fingers into two halves. The cord of the écraseur is now passed over one half, and well behind the disease, and, if the whole tongue is to be removed, the cord of a second écraseur over the other half. The cord being tightened by screwing up the écraseur, the tongue is cut through. The lingual artery, with the gustatory nerve, is drawn out in the form of a loop by the cord of the écraseur (Fig.179). A ligature should be passed round the artery with an aneurism needle, and the artery severed in front of the ligature. The anterior part of the tongue will now come away, leaving the ligature on the artery in the stump of the tongue. The above is a slight modification of the operation introduced by Mr. Morrant Baker.

3. *Excision with the scissors* as practised by Mr. Whitehead, consists in drawing the tongue well forward by a ligature through its tip, dividing the frænum, and then separating the tongue from its attachments beginning from below by a series of short snips with blunt-pointed scissors, tying the lingual arteries, if seen, before they are divided, or else immediately they are cut. To prevent hæmorrhage during the operation, some Surgeons first tie the lingual artery in the neck, whilst others, for fear of blood entering the trachea, perform tracheotomy, and plug the trachea with Hahn's tampon cannula, or merely introduce an ordinary tracheotomy tube, and plug the pharynx firmly with a sponge during the operation. All such measures are however in my opinion quite unnecessary, and only add to the danger of the operation. Should bleeding occur it can always be arrested temporarily by merely passing the finger into the pharynx and pressing the tongue against the inner surface of the jaw, and then as soon as the mouth has been sponged clear of blood the bleeding vessel can be seized and tied. Or Lockwood's clamp for compressing the lingual artery may be used during the operation if the Surgeon is at all nervous of bleeding, the only objection to it being that it is apt to get a little in the operator's way. When Hahn's cannula is used it is often kept in for several days after the operation for the purpose of excluding septic discharges from the air-passages and so preventing septic pneumonia. The advantages claimed for the scissors *versus* the écraseur are that a cleaner cut surface is left and consequently that the

Surgeon can be more certain of having removed the whole of the disease, that less sloughing occurs, and that the operation is more quickly performed. Where, however, the tongue is adherent to the floor of the mouth and hence cannot be drawn forward, or the mouth cannot be opened sufficiently wide, or the light is bad, removal with the scissors is attended with considerable difficulty, and under these circumstances removal with the écraseur will be found safer. As regards the amount of sloughing, I am not convinced that more attends the use of the écraseur than the scissors, and if care is taken to pass the cord of the écraseur well beyond the disease, as complete a removal can be ensured.

4. *Excision with the galvano-cautery* is strongly recommended by some Surgeons, but is open to the serious objection that it is liable to be followed by secondary hæmorrhage on the separation of the sloughs.

Whatever operation is undertaken, it will be facilitated when the disease is far back by splitting the cheek from the angle of the mouth to the masseter muscle; whilst, if the disease has invaded the bone, the lower lip may be vertically divided in the middle line, the incision continued on each side for a short distance along the lower border of the ramus of the jaw, the soft parts dissected up, and the infiltrated bone removed by the saw or bone-pliers. Division of the lower jaw in the middle line and separation of the two halves is a useful procedure when the floor of the mouth is implicated and the disease extends far back. The jaw should be united at the conclusion of the operation by silver wire, or ivory pegs. When the glands in the neck are much affected, and the disease extends far back, Kocher removes the tongue by an incision extending from the mastoid process to the hyoid bone, and thence to the jaw, extirpating the glands and tying the lingual artery in' the course of the operation. During the removal of the tongue chloroform should be administered by a tube passed through the nose (Junker's method), or if tracheotomy is performed, and the trachea plugged, through the cannula.

The *after-treatment* consists in dusting the stump with iodoform, painting it wiht Whitehead's iodoform varnish, packing the mouth with iodoform gauze, or frequently syringing it with Condy's or other antiseptic fluid. Some Surgeons recommended feeding with a tube for the first few days, or by the rectum. It is well to leave a ligature through the stump of the tongue, so that should recurrent hæmorrhage occur, it may be drawn forward, and the bleeding vessel more easily secured.

DISEASES OF THE UVULA, PALATE, FAUCES, AND TONSILS.

Uvulitis, or inflammation of the uvula, is a frequent accompaniment of pharyngeal catarrh. The uvula appears red, swollen, and œdematous, and often considerably elongated. If the inflammation does not yield to the remedies employed for the catarrh, scarification should be practised.

Elongation of the uvula may depend upon chronic catarrh of the pharynx, or upon conditions similar to those leading to chronic enlargement of the tonsils. The elongated uvula may come into contact with the back of the tongue, or even with the mucous membrane of the larynx, and in either case is productive of a troublesome tickling cough. If astringents fail, the end of the uvula may be amputated.

Cleft palate is a congenital defect due to an arrest of development of the processes which normally grow inwards from the superior maxillary and palate bones, and meeting each other and the vomer in the middle line, and the premaxillary bone in front, form the hard and soft palate. This arrest of development may be complete, the fissure extending in the middle line through the uvula and the soft and hard palate, and thence through the alveolar process in the line of suture either on one or both sides of the premaxillary bone (Fig. 180). It will in this case be generally combined with double or single hare-lip respectively. When the arrest is only partial, the cleft may extend through the uvula alone, or through the soft palate as well, or the soft and part of the hard palate; whilst, in other instances, the alveolar process only on one or both sides of the middle line may be notched, as occurs so often in hare-lip. The vomer, which is continuous in front with the premaxillary bone, either presents a free border in the middle of the cleft, or is attached to one or other margins of the cleft. *The consequences* of cleft palate vary with the age of the patient and extent of the cleft. In infancy, suction and deglutition are seriously interfered with; whilst later, the voice, articulation, taste, smell, and hearing, may all be impaired.

Treatment.—The infant if unable to take the breast in an erect or semi-recumbent posture, must be fed with the mother's milk by a spoon passed well to the back of the mouth, or by a feeding-bottle with a large teat to act as a plug to the cleft. The operation for the cure of the deformity should be undertaken before the child begins to speak, which is generally about a year later than usual; but not in infancy, as bleeding is then badly borne, and the cleft of the bony palate diminishes in width during the first three years of life. Infants, moreover, are very liable to such ailments as catarrh of the pharynx and lungs, and coughing and sneezing tend to tear the parts asunder. The cleft in the hard and soft palate should be closed at the same time. Hare-lip, if present, should be operated on in infancy.

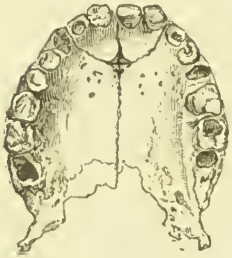


Fig. 180.—The lines of suture in the hard palate.

Staphyloraphy or closure of the soft palate. Chloroform having been given by Junker's apparatus with the tube passed through the nose, and the mouth widely opened by a Smith's gag, which depresses the tongue at the same time (Fig. 181), one end of the bifid uvula is seized with long forceps, and the edge of the cleft pared from below upwards, and the paring repeated on the opposite side. The uvula and the lower part of the palate are then united with horsehair, the upper part with silver wire. The wire sutures are best passed by Smith's needle, by which they can be carried through both sides of the cleft by one transit of the needle. The needle, shown in

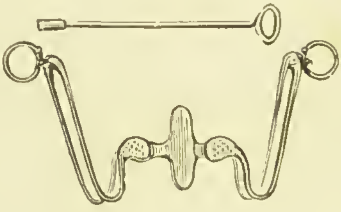


Fig. 181.—Smith's gag for cleft palate, with key.

Fig. 182, has "a small reel attached behind the handle to hold the wire, and a small serrated wheel half way up the handle to protrude the wire from its tubular point." The horsehair may be passed across the cleft by the needle shown in Fig. 183, and as the point of the needle protrudes from the palate, the end of the horsehair seized and drawn out by the nibbed forceps or by the suture-catcher (Fig. 184) and the needle withdrawn. The silver sutures should be fastened by the wire-twister (Fig. 185) and cut off short, care being taken to hold the edges of the cleft merely in apposition and not to apply any tension. The horsehair should be tied with a treble Surgeon's knot. When the parts have been brought together any undue tension should be relieved by making lateral incisions through each side of the soft palate parallel to the cleft and just internal to the hamular process with a tenotome on a long handle. By these incisions the levator palati muscles are divided. The palato-pharyngei may also be divided

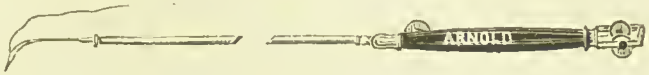


Fig. 182.—Smith's needle for passing wire-sutures in cleft palate.

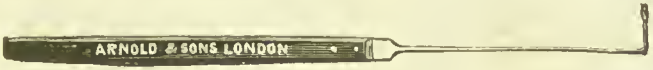


Fig. 183.—Smith's palate needle for passing horsehair sutures in cleft palate.

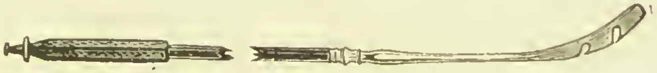


Fig. 184.—Suture-catcher.

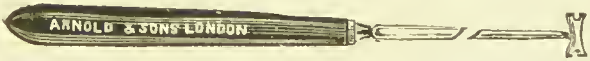


Fig. 185.—Wire-twister.

if necessary by notching the posterior pillars of the fauces with scissors.

Uranoplasty, or closure of the hard palate. The soft palate having been previously brought together in the way described, the operation on the hard may be begun at that stage where the tension becomes such that the soft parts can no longer be brought together. The edges of the cleft having been pared, an incision from a quarter to three-quarters of an inch long should be made on either side of, and parallel to, the cleft through the muco-periosteum down to the bone (Fig. 186, E, E). It should fall a little distance from the alveolar process, so as to avoid wounding the anterior palatine artery. Into one of these incisions a raspatory or an aneurism needle with a short curve should be introduced, and the muco-periosteum separated from the bone along the whole length of the cleft in the hard palate, avoiding the neighbourhood of the posterior palatine foramen, through which the anterior palatine artery runs. The attachment of the muco-periosteum to the posterior margin of the hard palate should be divided with curved scissors passed through the cleft and behind the soft palate, which should be drawn forwards to facilitate this step of the operation. Pressure should be made upon the parts with a small sponge by an assistant, whilst the muco-periosteum is being separated in like manner on the opposite side. Wire sutures should now be passed in the way described for uniting the soft palate, and any tension relieved by prolonging the cuts made for the introduction of the raspatory forwards or backwards as the case may require. Hæmorrhage, though often sharp, is seldom, however, severe, and may generally be stopped by pressure or syringing with ice-cold water, the head being turned over to one side to let the

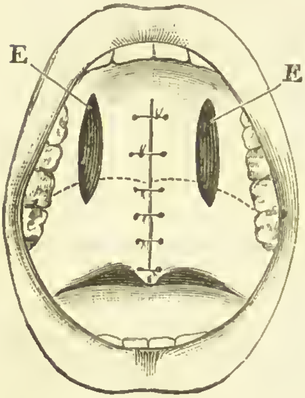


FIG. 186.—Position of the lateral incisions, E, E, through the muco-periosteum, in the operation for cleft of hard palate. The dotted line indicates the line of junction of the hard and soft palate. (Bryant's Surgery.)

blood escape, or if it becomes serious by plugging the posterior palatine canal with a small peg of wood.

After-treatment.—The patient should be fed on iced milk for the first day, and then on soft food for a fortnight. The sutures may be left in for three weeks or a month; if the patient is unruly they should be removed under chloroform. The cleft ought to heal by the first intention, and the lateral cuts for taking off tension, by granulation. If a portion of the cleft fails to unite by the first intention it will often heal up subsequently by granulation; if not, a second operation must be undertaken. It is somewhat doubtful whether the mucoperiosteum ossifies.

NECROSIS OF THE HARD PALATE is generally due to the breaking down of syphilitic gummata, and is followed by perforation and at times by destruction of the greater part of the hard and soft palates, and septum of the nose. *Treatment.*—Large doses of iodide of potassium, and when the ulceration has ceased, an obturator to close the perforation, and later a plastic operation if practicable.

ACUTE TONSILLITIS may be the result of taking cold in a person in feeble health, or the subject of the rheumatic diathesis, or who from previous attacks has become predisposed to the disease; sometimes it is due to septic poisoning, as from the inhalations of sewer gas; or it may occur in the course of other diseases, as scarlet fever. *Signs.*—It generally begins with a slight chill, or even a rigor, followed by high temperature, furred tongue, offensive breath, salivation, pain darting to the ear and increased on swallowing, and swelling of the glands behind the angle of the jaw. If the mouth can be sufficiently opened one or both of the tonsils are found to be red and swollen, and often in contact, blocking up the fauces. The neighbouring parts are congested and swollen, and, in the variety known as *follicular* tonsillitis, a secretion is seen oozing from the mouths of the inflamed follicles. The inflammation may now subside, or terminate in suppuration (*quinsy*), which may be known by the pain becoming of a throbbing character, and a sense of fluctuation or softening on palpation. *Treatment.*—At the onset a sharp purge should be given, whilst large doses of perchloride of iron, quinine, or salicylate of soda, with the local insufflations of bicarbonate of soda, may be tried as abortives. Where suppuration threatens, the throat should be steamed, and hot camomile mattresses or linseed poul-

An operation [illegible]

tices applied externally. As soon as the abscess has formed, an incision should be made with a bistoury, guarded by wrapping it round with sticking-plaster to within half an inch from the end, and directing the point towards the middle line to avoid injuring the tonsillar arteries and the internal carotid.

CHRONIC ENLARGEMENT OF THE TONSILS consists of a hypertrophy of the normal tissue of the tonsil, and is very common in strumous children, in whom it is frequently associated with adenoid growths in the vault of the pharynx. At times it appears due to oft-repeated attacks of acute tonsillitis. The *symptoms* to which it may give rise are: a nasal tone of voice; a peculiar vacant expression, acquired by the child constantly breathing with the mouth half open; regurgitation of fluids through the nose; snoring during sleep; distressing dreams, from the imperfect aëration of the blood; and recurring attacks of acute or sub-acute tonsillitis; whilst deafness, from implication of the Eustachian tube and middle ear in the chronic inflammation, may sometimes be induced, and even an alteration in the shape of the chest, and possibly phthisis. The tonsils appear irregularly enlarged, often almost blocking up the fauces, but, unless inflamed, of a natural colour, or perhaps slightly paler than natural. *Treatment.*—In young children the affection may be cured by persistent painting with the tincture of perchloride of iron or tincture of iodine, combined with the internal use of cod-liver oil and syrup of phosphate of iron. In older children, or where the tonsils are much enlarged, they should be excised, either with the knife, or better, with the guillotine, and this should be done before the voice has become seriously affected or other mischief has ensued. The hæmorrhage attending the operation, though usually slight, has at times been alarming. Gargling with cold water will generally stop it; but if this fails, ice, or astringents, as tannic acid, or pressure with a pencil guarded with lint, will nearly always succeed. Should a bleeding vessel be seen, it should be tied or twisted. In exceptional cases, the common carotid has had to be tied.

ULCERATION OF THE FAUCES, PALATE, AND TONSILS may be simple, gangrenous, syphilitic, strumous, and malignant.

Simple ulceration, the so-called ulcerated sore throat, is generally the result of debility, induced by over-work in a close atmosphere, and hence is frequent in workers in hospital wards, where it is known as hospital sore-throat. Change of air, a nourishing diet, quinine and port wine, with a gargle of chlorate of potash, will usually relieve it. If neglected it may assume a *gangrenous* form, and extensive sloughing may then ensue, with constitutional symptoms of blood-poisoning, which often proves rapidly fatal. Stimulants and fluid nourishment should be frequently administered, and quinine, perchloride of iron, or ammonia and bark, given internally. Tracheotomy, if the larynx becomes involved, may be necessary.

Syphilitic ulceration may be superficial or deep. The *superficial* ulcers are common in the early stages of syphilis, and may be accompanied by mucous tubercles. *Deep* ulcers, due to the breaking down of gummata, occur in the later stages as irregular excavations with sharply-cut edges and a sloughy base, but are unattended with induration. On healing they are often productive of much contraction (see *Pharyngeal Stenosis*).

The so-called *strumous ulceration* occurring in strumous children bears a general resemblance to the syphilitic, and is believed by some really to be the result of congenital syphilis. Like the syphilitic it may lead to extensive destruction of the parts.

Malignant ulceration is due to the breaking down of epitheliomatous and sarcomatous growths. It may be known by the sinuous, everted, and indurated edges of the ulcer and other signs of malignancy.

TUMOURS OF THE TONSIL.—*Sarcoma* and *epithelioma* occasionally occur in the tonsil. They grow rapidly, soon affect the lymphatic glands in the neck, and extend to surrounding parts. Unless detected and removed whilst they are quite small and localized to the tonsil they are beyond the reach of surgery. Other tumours in this region are very rare.

DISEASES OF THE GUMS AND JAWS.

HYPERTROPHY of the gums has been observed as a congenital affection, and may be met with where there is overcrowding of the teeth as a lobulated fringe-like growth of the gums, which, in severe cases, may so surround the teeth that they appear as if buried in it. The hypertrophied portion should be shaved off, and one or more of the teeth extracted.

POLYPI of the gums, as they are called, are merely overgrowths of the little tongue of gum between the teeth, and appear generally to depend on the presence of tartar or caries. The offending tooth should be scaled, stopped or extracted, and the growth cut off.

PAPILLOMATA, or warty growths, occasionally occur on the gums. They are generally pedunculated, and can be readily snipped off with scissors.

SPONGY GUMS may occur as the result of scurvy or the abuse of mercury, and are sometimes met with in strumous children. The condition is often associated with superficial ulceration. The *treatment* consists in the removal of the cause, the use of an astringent mouth-wash, and the constitutional remedies appropriate to scurvy or struma.

ALVEOLAR ABSCESS may be quite superficial (*gum-boil*) and merely require a slight prick; or it may form around the fang of a carious tooth, and then either make its way to the surface by the side of the tooth, or expand the alveolus and perforate the bone. In the latter case it may track below the reflexion of the mucous membrane from the gums to the cheek, and point about the angle of the jaw or on the cheek, and after opening leave an intractable sinus. In the upper jaw it sometimes also tracks along the hard palate and may lead to necrosis of the bone. It is attended with severe throbbing pain, deep-seated swelling, and often great œdema of the face and eyelid. *Treatment.*—The offending tooth should be extracted, hot fomentations and bread-poultices applied inside the mouth, and the sinus divided transversely from within the mouth to prevent an external opening being formed. If a sinus exists the carious tooth or dead bone must be removed before it will heal; scraping the sinus will then facilitate the healing.

EPULIS.—This term, though formerly employed to signify any tumour growing upon the gums, is now usually restricted to the variety that was then distinguished as the fibrous or common epulis. Epulides consist principally of fibrous tissue, but may sometimes contain a few myeloid cells. They frequently appear to depend upon the irritation of carious stumps, and spring from the peri-odontal membrane lining an alveolus. Beginning as a swelling of the little tongue-like process of gum between the teeth, as they increase in size they appear as hard, fleshy, circumscribed, smooth, or slightly lobulated, elastic growths, covered by mucous membrane. When they have existed some time ulceration of the surface may occur and the teeth become loosened or fall out. *Treatment.*—They should be excised with bone-forceps or a small saw, taking care to cut away a small piece of the bone beneath, as otherwise they are apt to return. When quite small they may be shaved off and the bone at their base slightly gouged away, and the offending tooth or teeth removed.

MYELOID SARCOMA (*myeloid epulis*) is occasionally met with in the gums as a rapidly-growing vascular tumour of a purplish-red colour and soft spongy consistency. It should be very freely removed, as otherwise it will return. The hæmorrhage during removal is generally free, and may require the actual cautery to restrain it.

EPITHELIOMA (*malignant epulis*) of the gums is rare. In the upper jaw it has a marked tendency to creep up into the antrum (*creeping epithelioma*) and to simulate caries or necrosis of the jaw. Free excision, with removal of the upper jaw if the antrum is involved, should be undertaken if there is a fair chance of getting the whole of the disease away and the glands are not much involved.

INFLAMMATION AND ABSCESS OF THE ANTRUM is generally due to the irritation of the fang of a carious tooth. It is attended with deep-seated pain, followed by swelling, œdema, heat, and redness of the cheek and lower eyelid, and when very acute, by sharp constitutional disturbance. The pus may overflow into the nose, or escape by the side of a tooth; or, in other instances, may distend the cavity and cause the bony walls to bulge. The *treatment* consists in providing a free exit for the pus as soon as formed, either by removing the carious tooth and perforating the antrum through the bottom of the alveolus or, if the teeth are sound, by perforating the anterior wall within the mouth through the canine fossa. The cavity should then be kept aseptic by iodoform or other antiseptic.

CLOSURE OF THE JAWS is the term applied to a condition in which the lower jaw cannot be opened, at least, not to any extent. It may be due to—1, spasm of the masseter muscle, consequent on the irritation attending the eruption of a wisdom-tooth for which there is not room; 2, cicatricial contraction, following ulceration of the mucous membrane induced by cancrum oris, syphilis, lupus, the abuse of mercury, &c.; and 3, rarely, ankylosis of the tempero-maxillary joint. *Treatment.*—When dependent upon the eruption of a wisdom-tooth, the tooth itself, or under some circumstances the second molar, must be extracted. When dependent upon cicatricial contractions, the forcible opening of the mouth by a screw-gag and maintaining it open by a cork placed between the teeth will, in slight cases, suffice. In other instances I have found division of the cicatricial bands, and subsequently keeping the jaws separated, successful, although this proceeding does not appear to have always answered in the hands of others. When the bands are very dense or the closure depends upon ankylosis of the tempero-maxillary joint, a new articulation must be made by dividing the ramus of the jaw, and removing a wedge-shaped piece in front of the contractions.

NECROSIS OF THE JAWS.—Necrosis is more common, and when it occurs, more extensive in the lower than in the upper jaw, a fact due in part to the poorer blood-supply of the former, and in part to the predilection of necrosis for compact rather than for cancellous bone. Though the necrosis may affect the whole of the jaw, it is more often limited to the alveolar process or to the anterior wall. The teeth may loosen and fall out; but at times they retain their connection with the gums and remain *in situ* after the removal of the sequestrum. The *causes* of necrosis of the jaw, as of necrosis elsewhere, generally depend upon inflammation of the periosteum or bone, which in the case of the jaw appears especially to be induced by the fumes of phosphorus, the abuse of mercury, carious teeth in strumous subjects, syphilis, the exanthemata, cancrum oris, and lastly, injury, as in extracting a tooth. *Phosphorus-necrosis* is generally believed only to affect the subjects of carious teeth, but some maintain that it is a local manifestation of a general phosphorus-poisoning. It is much less common since the amorphous form of phosphorus has been used for making matches. The production of new bone in necrosis of the lower jaw is generally excessive; and there are several specimens in St. Bartholomew's Hospital Museum showing almost complete reproduction of the whole jaw. In the upper jaw new bone is not formed after complete removal. In phosphorus-necrosis a characteristic pumice-like deposit of new bone is formed. *Symptoms.*—Necrosis generally begins with severe pain and deep-seated swelling, which may at first be mistaken for toothache or alveolar abscess, followed by suppuration and bursting of the abscess, either in the mouth or externally on the face, and the formation of sinuses. The breath, as a rule, is horribly foul, and there is sharp constitutional disturbance which, in phosphorus-necrosis, is sometimes excessive, and may end in septicæmia or pyæmia. On probing the sinus, dead bone is detected. This sign will usually distinguish necrosis from the creeping form of epithelioma, for which it is apt to be mistaken. *Treatment.*—The bone as soon as loose should be removed, if possible, through the mouth. In the meantime the parts should be kept aseptic by syringing with Condy's fluid or carbolic lotion, or by insufflation of iodoform, incisions being made through the periosteum to ensure a free drain, or Cargill's respirator may be worn to neutralize the fœtor. Internally, tonics and stimulants and nourishing diet should be given, and iodide of potassium if there is a syphilitic taint.

TUMOURS OF THE UPPER JAW may be cystic or solid, and the latter innocent or malignant; whilst cysts may likewise occur in the malignant solid tumours.

Cystic tumours may be produced: 1. In connection with the fang of a carious tooth. 2. By an error in development of the enamel sac covering the crown of a tooth (*dentigerous cysts*); and 3. By obstruction of a mucous follicle in the lining membrane of the antrum. These cysts usually contain a serous, gelatinous, or a brownish fluid, in which cholesterine is often found. The condition known as *Dropsy of the antrum*, and formerly believed to depend merely upon an accumulation of fluid in that cavity owing to the occlusion of the opening into the nose, would appear to be due to one of these mucous cysts completely filling the antrum.

Dentigerous cysts, which may also occur in the lower jaw, are due to an error in the development of the enamel sac usually of the permanent teeth. They differ from the ordinary dental cyst, depending upon the irritation of a decayed fang, in that in the latter the fang will generally be found projecting into the cyst; whereas in the dentigerous variety, the crown alone, which has not been cut, or in some cases the whole tooth, will be found in the cyst.

Solid tumours may spring from the periosteum covering the exterior of the bone, or from the mucous or the periosteal lining of the antrum. They may have a fibrous, cartilaginous, osseous, myxomatous, adenomatous, sarcomatous, or carcinomatous structure; but fibrous and sarcomatous tumours are the most common, whilst cartilaginous are very rare. Ossification of the sarcomatous growths is of occasional occurrence. They may be closely simulated by tumours of a like diversity of structure growing from the malar bone, the spheno-maxillary fossa, or the base of the skull.

Symptoms and diagnosis.—Clinically, it is not always possible to determine the exact structure of these tumours, nor is it essential, the Surgeon's aim being rather to distinguish the solid from the fluid, and the innocent from the malignant, and to make out their origin and present attachments. When the tumour, whether cystic or solid, innocent or malignant, begins in the antrum, it sooner or later fills that cavity, and then in its further growth causes its walls to bulge in various directions. Thus, the protrusion of the anterior wall causes a swelling on the cheek, of the internal wall an obstruction in the nose, of the inferior wall a depression of the palate, and of the superior wall a protrusion of the eye. A rounded projection on the cheek; a sensation of fluctuation felt through the anterior wall of the antrum with the finger in the mouth, or egg-shell-like crackling produced by the yielding of the thinned and partially absorbed walls; the presence of a carious tooth, or the absence of one of the teeth in the series, will point to the cystic nature of the swelling, and puncture with a trocar and cannula, will clear up any doubt. Should the tumour be solid, it will probably be *innocent* if there be slow growth, absence of pain and glandular enlargement, non-implication of the skin, and non-infiltration of surrounding parts; but *malignant* if there be rapid growth, severe pain, early escape through the walls of the antrum, implication of the skin, involvement of glands, and protrusion of a fungus in the mouth, nose, or on the cheek. In malignant disease, moreover, the patient will probably be either young in the case of sarcoma, or advanced in life in the case of carcinoma, but if a small piece of the growth can be obtained, a microscopical examination will settle the point. When the growth springs from the malar bone, it may either project forwards on the cheek, or into the mouth between the cheek and the bone, and the bulging of the walls of the antrum will be absent. When it arises from the spheno-maxillary fossa or base of the skull, it will commonly project into the naso-pharynx, where it may be detected by the finger or rhinoscope, while the whole maxillary bone will be pushed forward. It should not be forgotten, however, that tumours beginning in the antrum, especially the fibrous and sarcomatous, encroach upon the surrounding parts, and conversely, that the cavity of the antrum may be invaded by growths not primarily connected with it; so that when tumours in this region have attained a large size it may be impossible to determine their origin, or, indeed, the whole of their actual attachments.

Treatment.—For cystic tumours, excision of a portion of the wall from within the mouth will generally suffice, if a free drain is subsequently ensured. At times the thinned walls of the cyst may be crushed together by the fingers with advantage. Where the cyst is associated with a solid growth, the latter may sometimes be scraped away, otherwise the upper jaw must be partially or completely removed. Where the tumour is *solid*, and of an *innocent* nature, and entirely confined to the antrum, it may be removed by excision of the superior maxilla, but as a rule no more of the bone should be taken away than is absolutely necessary, the orbital plate and hard palate being preserved if possible. When the tumour arises behind the bone, there is often great difficulty in getting it away, as its attachments may be more extensive than is imagined. If thought advisable to attempt its removal this may be done by excising the superior maxilla, and clearing away the growth; or the maxilla may be turned outwards, the growth removed, and the bone replaced (*Langenbeck's method*).

When the growth is *malignant* and confined to the antrum, the superior maxilla may also be excised; but when it has invaded the surrounding parts, it becomes not only a question whether it can be completely got away, but whether the immunity from its return will not be too short for the patient to undergo the risk of the operation.

COMPLETE EXCISION OF THE UPPER JAW.—Having extracted the central incisor tooth on the diseased side, make an incision down to the bone in the way shown by the dark line in Fig. 187. Dissect back the flap thus marked out from the bone, securing the larger arteries as they are divided. Make a longitudinal incision through the mucous membrane lining respectively the floor of the nose, and roof of the mouth as far back as the soft palate, and then a transverse one along its junction with the hard palate on the diseased side. Now pass one blade of the long jaw-forceps into the mouth and the other into the nose, and divide the alveolar process and hard palate; cut through the nasal process of the superior maxilla, and then through the malar bone, carrying the forceps into the spheno-maxillary fissure. Seize the bone with lion forceps, and wrench it away from its remaining attachments. The internal maxillary, or any other large artery, should be tied, and hæmorrhage from the smaller restrained by plugging the wound with strips of iodoform gauze. When the bleeding has stopped, any growth that may remain should be cut away or destroyed with the actual cautery. Unite the edges of the wound with horsehair sutures and with hare-lip pins. Healing occurs readily and with little deformity. An obturator with false teeth should subsequently be fitted to the mouth.

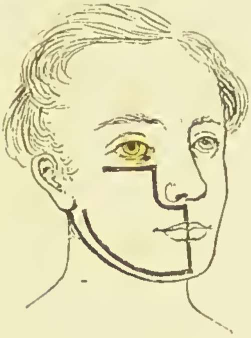


Fig. 187.—Lines of incision for removal of upper and lower jaw.

Partial excision of the upper jaw usually consists in leaving the orbital plate, and is done by dividing with a key-hole saw the front wall of the antrum along the margin of the orbit, and completing the operation as above described.

Resection of the upper jaw (*Langenbeck's operation*) consists in turning the maxillary bone outwards so as to get at a tumour behind it, and then replacing the bone. As the connections of the bone along its outer part are left intact, its vascular supply is not completely cut off, and it soon forms fresh adhesions when placed back in position.

Tumours of the lower jaw, like those of the upper, may be cystic or solid, innocent or malignant. They may grow from the periosteum covering either the outer or the buccal aspect of the jaw, or from the interior of the bone which they then expand around them. The osseous tumours usually take the form of exostoses, and are not uncommon about the angle of the jaw. The more regular shape of the lower jaw, its compact structure, the absence of a cavity like the antrum, its more isolated condition, and the absence of surrounding cavities like the nose, orbit, and spheno-maxillary fossa, make the diagnosis of tumours in it more easy. The signs are similar to tumours of the upper jaw, which see.

Treatment.—Cystic tumours are best treated by free incision, and, if large, by excision of a portion of their wall. In removing solid innocent tumours no more of the bone should be sacrificed than is necessary to extirpate the disease; and such removal, when possible, should be done from within the mouth. Myeloid growths springing from the interior of the bone may often be enucleated, and not recur for many years, or not at all. Where the tumour is large and encroaches upon the ramus, the affected half of the jaw, or if both halves are affected, the whole jaw, should be removed by disarticulation, as if the ramus is merely sawn across, leaving the coronoid process and condyle, these are apt to be drawn forward by the temporal and external pterygoid muscles and prove a constant source of annoyance. When the growth is malignant or of large size, and the skin and neighbouring soft parts are implicated and the glands extensively involved, no operation as a rule is admissible. Cysts developed in connection with solid growths may be laid open and the tumour scraped away, or part or the whole of the jaw, if the growth is malignant, may be removed.

EXCISION OF THE LOWER JAW.—Having extracted the central or the lateral incisor tooth, make an incision down to the bone (in the way shown in the black line in Fig. 187) through the lower lip, along the lower border of the jaw, and thence up the ramus, nearly but not quite to the lobule of the ear to avoid the facial nerve, tying both ends of the facial artery as it is cut. Dissect up the flap thus formed from the bone, and divide the bone with saw and forceps opposite to where the tooth has been extracted. Seize the bone with the lion forceps, drawing it outwards and upwards, and divide the soft tissues on the inner surface with a narrow-bladed scalpel, keeping close to the bone to avoid the gustatory nerve and the submaxillary gland. The origin of the genio-hyo-glossus should be left, if possible, as otherwise the tongue tends to fall backwards, and has before now caused suffocation. If this muscle must be divided, pull the tongue forward by a ligature through its tip. Next separate the internal pterygoid, depress the jaw, and divide the temporal muscle at its insertion into the coronoid process. Open the articulation from the front, divide the external pterygoid, and carry the knife behind the condyle, taking care not to rotate the jaw outwards lest the internal maxillary artery be stretched round the neck of the condyle and be torn or divided.

DISEASES OF THE NOSE AND NASO-PHARYNX.

ACNE ROSACEA is a dilated or congested condition of the capillaries of the nose, usually accompanied in its later stages by hypertrophy of the sebaceous follicles. It is attributed to indigestion, exposure to cold, sexual disturbance, or abuse of alcohol, and is most common in women. *Treatment.*—Remove the cause, regulate the diet, and attend to the general health. Locally apply sulphur ointment or perchloride of mercury lotions. In severe cases the dilated vessels may be incised and the resulting hæmorrhage restrained by touching them with perchloride of iron, but only small portions of the disease should be thus treated at a time.

LIPOMA NASI is a hypertrophy of the skin, subcutaneous tissue, and sebaceous follicles of the nose, and not, as the name implies, an increase in the fatty tissue. It is characterized by the formation of irregular pendulous lobe-like masses, usually situated on the tip and alæ of the nose, and often of a bluish-red colour. It occurs in elderly men, generally as the result of alcoholism. *Treatment.*—The masses should be shaved off, taking care not to cut through the cartilages into the nostrils, and the parts left to granulate. The result is very successful.

SYPHILIS, RODENT ULCER, LUPUS and EPITHELIOMA may all attack the exterior of the nose, but require no special description here.

EPISTAXIS or BLEEDING FROM THE NOSE is a symptom of many and various conditions. Thus—1. In the young it often appears to occur spontaneously from congestions of the mucous membrane, and is especially common in girls about the age of puberty. 2. In the plethoric it may be due to congestion of the brain or liver, and then appears to give relief to the over-full vessels. 3. In the old or cachectic, on the contrary, it may be due to a poor or watery condition of the blood, such as is present in cirrhosis of the liver, heart-disease, granular kidney, &c. 4. It may also occur in scurvy, some forms of fever, and in the hæmorrhagic diathesis. 5. It is common after blows or other injuries of the nose; and 6. It may be a symptom of fracture of the base of the skull, or of a fibrous or malignant polypus in the nose or naso-pharynx. The *symptoms* are usually evident. The blood generally comes from one nostril, occasionally from both; but it may pass through the posterior nares and be swallowed, and being afterwards vomited, simulate hæmatemesis; or it may irritate the larynx, cause cough, and may then be mistaken for hæmoptysis. On looking into the mouth in such cases, however, the blood will be seen trickling down the back of the throat; whilst it may also be apparent on examining the nose with a speculum. The *Treatment* will depend upon the cause. Spontaneous hæmorrhages occurring in the young, except as the result of the hæmorrhagic diathesis, generally stop of their own accord, and require no special treatment beyond those remedies common in domestic use. When due to congestion and apparently salutary, the bleeding should not be too soon checked. In cachectic subjects it is often difficult to control; rest on the back with the arms raised, sucking ice, cold or hot douches, ice to the nose, subcutaneous injections of ergotine (grs. iij.), gallic acid, lead and opium and small doses of ergot or of perchloride of iron, may then be tried. Or pellets of cotton-wool soaked in solutions of cocaine (20 °/₀) may be placed in the nostril, or pressure made on the upper lip just below the ala of the nose in order to compress the nasal branch of the superior coronary artery from which the blood is said often to be derived. If the hæmorrhage cannot be thus controlled, the posterior nares should be plugged. The best means of effecting this is by the india-rubber inflating tampon. This consists of an india-rubber tube, with two dilatations upon it so sized and shaped that when inflated they will accurately fill the posterior and anterior nares respectively. It is passed in flaccid by means of a long probe, and inflated when in position by the mouth or a small syringe, the escape of air being prevented by clamping the tube. Re-inflation is necessary from time to time. The posterior nares may also be plugged by Bellocq's sound (Fig. 188) in the following manner. A pledget of lint or cotton-wool rather larger than the aperture to be filled (that is, about half an inch by an inch, or roughly, the size of the last joint of the thumb) is taken, and round the middle of this is tied a doubled piece of stout thread, a long loop being left on one side, and two ends on the other, one of which is cut off short. The sound is then threaded with a separate length of thread, and passed close through the nostril, and when the end has reached the pharynx, the spring is projected,

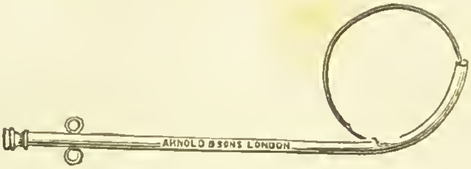


FIG. 188.—Bellocq's sound.

coils round under the soft palate, and appears with the thread in the mouth. The thread is then seized, pulled forwards, and the cannula withdrawn, thus leaving one end of the thread through the mouth and the other through the nostril. The mouth end is now tied to the loop of thread attached to the pledget; and by making traction on the thread hanging from the nose the pledget, guided by the finger in the mouth, is drawn behind the soft palate into the posterior nares. The loop of thread is finally cut and tied over a pledget of cotton-wool or lint, which is forced into the nostril to form an anterior plug. Meantime the other end of the thread attached to the plug has been retained hanging out of the mouth and is now fastened loosely to the cheek, or it may be allowed to fall back into the pharynx. The plugs should be kept in for about two days. They are readily removed by cutting the thread over the anterior plug, and then withdrawing the posterior one through the mouth by means of the thread that is fastened to the cheek or is hanging loose in the pharynx. A substitute for Bellocq's sound, if this is not at hand, may be found in a soft india-rubber or gum-elastic catheter, which, with a hole drilled through it, can be used in a similar way.

EXAMINATION OF THE NASAL CAVITIES.—For the diagnosis of the internal diseases the nasal cavities should be illuminated by the laryngoscopic mirror, or the electric lamp, the alæ being separated by some form of nasal speculum, of which Duplay's and Fränkel's are the best (Figs. 189, 190). The posterior part of the nasal cavities can be explored by the finger passed behind the palate, or by a small mirror passed to the back of the throat (*posterior rhinoscopy*). For detecting necrosed bone the nasal probe may be used.

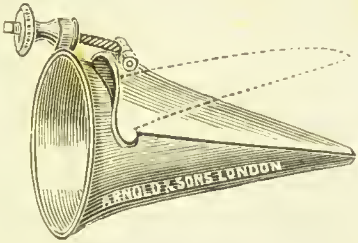


FIG. 189.—Duplay's nasal speculum.

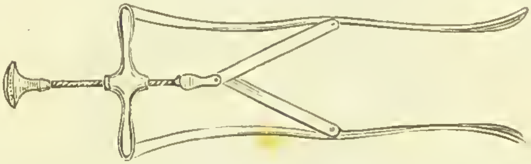


FIG. 190.—Fränkel's nasal speculum.

NASAL CATARRH, CORYZA, or inflammation of the mucous membrane of the nose, may be acute or chronic.

Acute catarrh, coryza, or cold in the head, will be found treated of in works on Medicine.

Chronic nasal catarrh is most common in the young, especially in children of a strumous habit. As exciting causes may be mentioned oft-repeated attacks of acute catarrh, adenoid vegetations in the vault of the pharynx, the irritation of noxious vapours or dust, the abuse of spirits, snuff-taking, &c. Several forms, all of which are probably different stages of the same disease, have been described. They will be classed here under the three heads of 1, the simple; 2, the hypertrophic; and 3, the atrophic, which is generally attended with fœtor. 1. The *simple* form is characterized by a thin mucous or muco-purulent discharge, and a congested appearance of the mucous membrane, but is unattended with any thickening, or formation of crusts, or with fœtor. If neglected, it is apt to pass into the next variety. 2. In the *hypertrophic* the mucous membrane, especially over the spongy bones, is greatly swollen and congested, and infiltrated with inflammatory material; while the glands are stimulated to excessive secretion, and pour out a thick yellowish-green muco-purulent discharge. It is characterized by symptoms of nasal obstruction, viz., stuffiness or blocking of the nose, nasal tone of voice, constant necessity to blow the nose, a vacant expression of countenance acquired by keeping the mouth open, trickling of the discharge down the pharynx and subsequent hawking of it up by coughing, and sometimes deafness from the spread of inflammation to the Eustachian tube. At times certain reflex phenomena are present, such as cough, asthma, and even epilepsy. The alæ of the nose often appear thickened and the inferior spongy bodies greatly enlarged. On posterior rhinoscopic examination granular pharyngitis is frequently discovered, with increase of the glandular tissue of the vault of the pharynx; whilst the hypertrophied posterior ends of the inferior spongy bodies may at times be seen almost completely blocking up the choanæ in the form of globular, irregularly-furrowed tumours (Figs. 191, 192). This variety, occasionally within a few months, but more often after it has lasted many years, may pass into the third variety. 3. The *atrophic*, sometimes called *dry* or *fœtid* catarrh, and by some *ozæna*, is apparently due to the shrinking of the inflammatory new formation infiltrating the tissues in the former variety, and the consequent atrophy of the mucous membrane and the greater or less destruction of the glands. It is characterized by the nasal cavities appearing preternaturally large, so much so in some cases that the wall of the pharynx and Eustachian tube may be seen on looking through the nostril. The spongy bodies appear decreased in size, and the mucous membrane is atrophied and paler

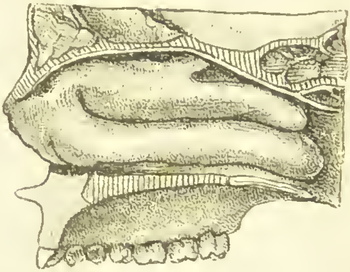


FIG. 191.—Hypertrophic nasal catarrh.
(St. Bartholomew's Hospital Museum.)

than natural, and covered with hard yellowish-green adherent crusts. Generally, though not invariably, the disease is attended with a horrible fœtor, which is usually thought to be due to the decomposition of the discharge beneath the crusts, the discharge being secreted in too small quantities and too thick to allow of the throwing-off of the crusts. By some the fœtor is believed to be due to the retention of the secretions in some of the sinuses communicating with the nose. In all forms an important point to remember is that ulceration does not occur.

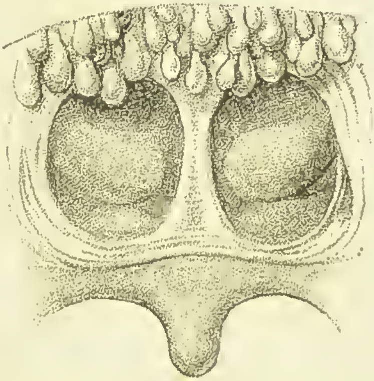


FIG. 192.—Hypertrophy of the posterior ends of the inferior spongy bodies, with adenoid vegetations in the vault of the pharynx.

Treatment.—In the early stages much can be done in the way of treatment, and, by perseverance, a cure may be obtained. In the atrophic variety relief from the distressing symptom of fœtor only can be expected. In all forms the general health must be attended to. Thus, in the strumous, cod-liver oil or maltine, and the syrup of the iodide or phosphate of iron, are indicated. Locally, in the simple and milder forms of the hypertrophic, the treatment consists in cleansing the parts and then applying astringents ; the cleansing may be accomplished by simply blowing the nose ; or if this is not sufficient, a cleansing fluid must be used. There are many of these. The one I have found most useful is that known as Dobell's solution. It should not be used as is so frequently done by Thudichum's nasal douche, as by its means the deeper recesses and upper portions of the nasal fossæ cannot be reached, and not only may much harm be done to the mucous membrane of the nose, but inflammation of the middle ear may be set up. The solution is best applied in the form of a coarse spray, either by the anterior or posterior nasal spray-producer worked by the double hand-balls (Fig. 193), or better by compressed air. When thoroughly cleansed, astringent solutions—best in the form of spray—should be applied, and of these may be mentioned the sulphate, sulpho-carbolate, and iodide of zinc. Or astringents or iodoform may be applied in the form of powders by the insufflator, or in that of gelatine bougies. Where there is great hypertrophy, the hypertrophied tissues must be destroyed by the local application of glacial acetic acid, fuming nitric acid, or the galvano-cautery; or the ends of the inferior spongy body if much enlarged, may be removed by the cold wire or galvanic écraseur. At times the whole of the spongy body may be removed with advantage. If the septum is deflected, it must be straightened; and if adenoid growths are present, they must be removed. In the atrophic form, little more can be done than cleansing and disinfecting the cavities by lotions of carbolic acid, borax, Condy's fluid, and the like; whilst the mucous membrane may be stimulated to secretion by the use of Gottstein's nasal tampons, or by the insufflation of sanguinaria, galanga, &c. Cubebs internally are often of service.

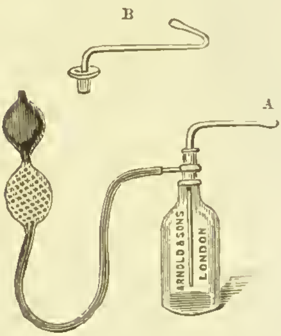


Fig. 193. — Spray-producer. A. Nozzle for anterior nares; B. Nozzle for posterior nares.

Tuberculous or strumous ulceration sometimes occurs, but struma more often manifests itself in the form of chronic catarrh as already described. It may lead to necrosis of the bone, falling in of the nose, and much deformity. Constitutional remedies, as cod-liver oil, must be given, and the parts cleansed by lotions, applications of iodoform, &c. Where obstinate, scraping of the part with a Volkmann's spoon, and removal of the dead bone, is the treatment indicated.

Syphilitic affections of the nose. In the early stages of syphilis, catarrhal inflammation and mucous tubercles are often met with, especially in infants, in whom they give rise to the obstructed and noisy respiration popularly known as snuffles. Later, extensive ulcerations, gummata followed by deep ulcers, necrosis or caries of the bones and cartilages, destruction of the septum with falling in of the nose and perforation of the palate may occur, and when combined with destruction of the soft tissues and skin, are productive of great deformity. When a small portion of bone in the deeper recesses is necrosed, it may not always be easy to find, but may be suspected by the continuance of a muco-purulent discharge and the fœtor so peculiar to dead bone, the presence of foul ulcers, the history or constitutional signs of syphilis, and the absence of signs of hypertrophic or atrophic catarrh. Often the bone may be struck on examination with the probe. *Treatment.*—Iodide of potassium should be given in large doses, combined, if necessary, with quinine or bark, and at times with mercury. Locally, the parts should be cleansed and disinfected by the application of carbolic or other sprays, and when dead bone can be detected it should be removed, if loose, through the anterior nares or from behind the palate, by forceps; but sometimes it may be necessary for obtaining a sufficient exposure to resort to the method of Rouge, or to cut through the upper lip and turn aside the ala of the nose. In congenital syphilis the administration of small doses of grey powder, followed by iodide of potassium and cod-liver oil, is productive of the most happy results. In the ulcerative form, iodide of potassium in large doses should be given.

LUPUS, though far more common on the exterior of the nose, may sometimes be met with in the interior. It then generally attacks the cartilage of the septum, leading to perforation. It is attended with a fœtid discharge. The ulcer is covered with scabs, and surrounded with reddish tubercles. *Treatment.*—Cod-liver oil, arsenic, and the complete destruction of the affected tissue by caustics, or by scraping, is the proper treatment.

RHINOLITHS OR NOSE-STONES may occasionally form in the nose from the deposition of phosphate of lime and mucus upon either a foreign body which has become lodged in the nose, or a portion of hardened secretion. They give rise to inflammation, swelling of the mucous membrane, and a fœtid discharge, and have been mistaken for osteomata, and even carcinomata. When detected they should be removed by forceps, or if too large for this, first broken by the nasal lithotrite.

POLYPI.—Three forms are described,—the gelatinous, the fibrous, and the malignant.

1. *Gelatinous or mucous polypi* most frequently spring from the mucous membrane covering the spongy bones, rarely from the roof of the nares, and scarcely ever from the septum. They usually have a myxomatous structure, that is, they consist of delicate connective tissue infiltrated with large quantities of mucin containing round and stellate cells, and are covered with ciliated epithelium. They are usually multiple, sessile or pedunculated, and of an oval, pyriform, or lobulated shape. The usual *symptoms* are a feeling of stuffiness in one or both nostrils worse in damp weather, a nasal tone of voice, and a mucous discharge. Certain reflex symptoms, such as asthma, cough, &c., are also occasionally present. On inspection, they appear as pinkish or greyish-white, semi-translucent, gelatinous, moveable bodies, soft and dimpling when touched with a probe. When high up, or far back in the nasal cavities, the speculum or rhinoscope may be necessary to detect them.

Treatment.—They are best removed by the galvano-cautery, as this is attended with less pain and no hæmorrhage. If the cautery is not at hand, they may be twisted off by the ordinary polypus forceps. The application of cocaine will much diminish the pain. When they project into the naso-pharynx, they may be removed from behind the palate. A snuff of tannic acid, used subsequently to their removal, is said to prevent recurrence, but I have not found it of much service

2. *Fibrous polypi* actually arising from the interior of the nasal cavities are very rare. Those commonly met with usually spring from the basilar process of the occipital bone or body of the sphenoid, that is, from the roof of the naso-pharynx, and then ought properly to be called *naso-pharyngeal*, as it is only after they have attained some size that they encroach upon the nasal cavities. They consist of fibrous tissue not infrequently mixed with spindle-cells, and often contain large thin-walled blood-vessels which give them an almost cavernous structure. The mucous membrane covering them is also very vascular. They may be sessile or pedunculated. As they increase in size, they invade and displace the surrounding bones, making their way into the nasal cavities and into the pharynx, and projecting below the palate and even into the interior of the skull. They are usually

[illegible]

met with in young adult life. The *symptoms* are obstruction of one or both nostrils, a mucous and often foul-smelling discharge, repeated attacks of hæmorrhage, deafness, obstruction to breathing and sometimes to swallowing, and in the later periods of the growth, to the characteristic deformity of the facial bones known as *frog-face.* They may be seen on looking into the nostril from the front, or by the rhinoscopic mirror from the back, or may be felt by the finger behind the soft palate. If not removed, they may end fatally from hæmorrhage, although they have apparently a tendency to undergo atrophy as the patient gets older. *Treatment.*—When of moderate size they are best removed by the galvano-cautery, the wire being passed through the nostril and directed over the base of the growth by the finger behind the palate. The pedicle should be then completely destroyed by the post-nasal electrode. When too large for this, an attempt may be made to remove them by electrolysis; this failing, or not being considered advisable, they must be exposed by a preliminary operation. If chiefly confined to the naso-pharynx, the soft palate should be split, and part of the hard palate, if more room is required, cut away (*Nélaton's operation*). When encroaching chiefly on the nose, a good exposure may be obtained by dividing the lip in the middle line, and turning it to one side with the ala of the nose; or if more room is required, the superior maxilla must be removed. Rouge's operation of turning up the upper lip and the cartilaginous portion of the nose after division of the septum, and the operation of Langenbeck of turning the maxillary bone outwards on the cheek, and then replacing it after removal of the growth, have their advocates. My experience of these procedures is not very favourable. The exposure obtained by the former is no better than that of turning back the ala; and the shock and hæmorrhage attending the latter renders it very dangerous. Many other methods and modifications of the above have been proposed, but for these a larger work on Surgery must be consulted.

3. *Malignant polypi.* — Sarcomatous and cancerous tumours may arise both in the nasal cavities and naso-pharynx, and then constitute what are called malignant polypi. They give rise to symptoms similar to those of the fibrous polypi already described, but their growth is more rapid, and they quickly infiltrate surrounding parts

and involve the neighbouring glands. They may occur both in the young and in the old. If a small piece can be removed, the microscope will reveal its nature. *Treatment.*—When the growth can be got completely away, early and free extirpation by one of the methods above described is the only treatment.

OZÆNA is a term which has been used very loosely by authors. By some it has been applied to all diseases of the nose attended with a foul-smelling discharge, whilst by others it has been restricted to the fœtid form of atrophic nasal catarrh. The term, therefore, as designating a disease, is misleading, and should be discontinued in this sense. For purposes of diagnosis it may be mentioned that it is a prominent symptom in the following affections of the nose: 1, atrophic nasal catarrh; 2, necrosis and caries, whether of syphilitic or other origin; 3, strumous, syphilitic and lupoid ulceration of the mucous membrane; 4, foreign bodies and rhinoliths in the nasal cavities; 5, some forms of new growth.

DISEASES OF THE SEPTUM NASI.—*Blood tumours* are occasionally met with as the result of injury. The blood is extravasated between the cartilage and the soft tissues, generally on both sides of the septum, causing in both nostrils a fluctuating circumscribed swelling which may be readily distinguished from abscess by its coming on immediately after the injury and by the absence of signs of inflammation. It should not be opened, as the blood will become slowly absorbed. It sometimes appears to be associated with fracture of the septum.

Abscesses of the septum are not very common. They may be due to injury or the breaking down of gummata, but occasionally occur without any apparent cause. When acute they may lead to perforation of the septum. The parts are hot, red, and swollen, and fluctuation may soon be detected. A free and early incision should be made.

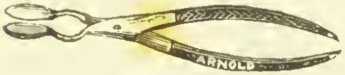


FIG. 194.—Author's forceps for straightening nasal septum.

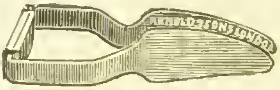


FIG. 195.—Retentive apparatus for deflected septum.

Gummata of the septum occasionally form beneath the perichondrium in the course of syphilis. They are readily dispersed with iodide of potassium, but if neglected may lead to necrosis and perforation of the septum and to destruction of the cartilage which may sometimes be so extensive as to lead to falling in of the bridge of the nose.

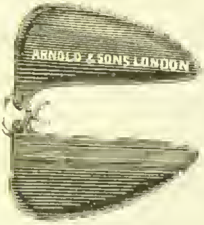


Fig. 196.—Nasal plugs.

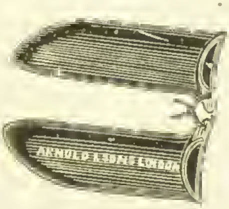


Fig. 197.—Hollow nasal plugs.

Deflection of the septum to one or other side may occur as the result of an injury, or as a congenital malformation. It appears as a swelling projecting into and obstructing one of the nasal cavities, whilst in the other cavity a corresponding depression is seen. The inferior spongy bone on the side of the concavity is often much hypertrophied. The deflection is generally attended with some lateral deviation or even depression of the lateral cartilages, and frequently gives rise to chronic nasal catarrh, and to many distressing symptoms, such as frontal headache, nasal tone of voice, passage of mucus into the pharynx, &c. *Treatment.*—The septum may generally be forcibly straightened by the forceps shewn in Fig. 194, and then retained in position for the first few days, while the parts are becoming consolidated, by the retentive apparatus shewn in Fig. 195, and subsequently by ivory or vulcanite plugs (Fig. 196). I have found hollow plugs (Fig. 197) useful in that they do not obstruct nasal respiration. In some instances portions of the prominent septum may be removed subcutaneously with advantage. Where the lateral cartilages are deviated they can generally be straightened, even after many years have elapsed since the injury. Great force, however, is required, and care must be taken, by properly padding the forceps, not to injure the soft parts. One of the best

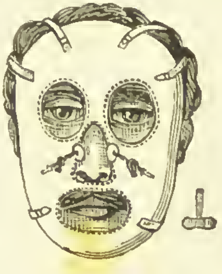


Fig. 198.—Author's nasal mask.

forms of retentive apparatus then is, perhaps, the mask shewn in the accompanying diagram, since by its means a fixed point is secured to work from.

Cartilaginous and osseous tumours of the septum, though rare, occasionally occur, and can be readily diagnosed from a deflection of the septum, by their hard and resisting nature and the absence of a corresponding depression in the opposite nostril. Their removal is the proper treatment.

ADENOID VEGETATIONS in the vault of the pharynx are very common in childhood. They are produced by the hypertrophy of the adenoid tissue which is so abundant in this situation, and are frequently met with in connection with enlargement of the tonsils, granular pharyngitis, and nasal catarrh, and if neglected may set up catarrhal otitis and incurable deafness. The chief symptoms to which they give rise are deafness, obstruction to nasal respiration, a nasal or "dead" tone of voice, and a vacant expression of countenance from the child breathing with the mouth half open. To the finger, behind the palate, they feel soft, pulpy, and velvety, "like a bag of earth-worms;" whilst in the mirror they appear as pink or reddish, sessile or pedunculated fringe-like masses more or less obscuring the posterior nares (Fig. 192). The *treatment* consists in removing them, which may be done in several ways. The softer ones may be scraped away with the nail of the finger behind the palate; those about the Eustachian tubes and side of the pharynx are best extirpated by Meyer's ring-knife (Fig. 200) introduced through the nose; and

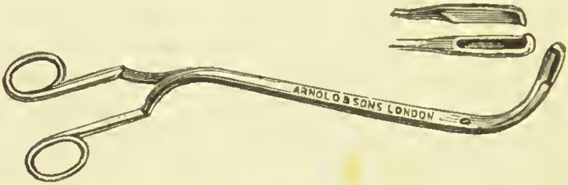


FIG. 199.—Author's modification of Loewenberg's forceps for removing adenoid vegetations.

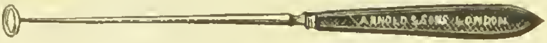


FIG. 200.—Meyer's ring-knife.

the larger ones, which are situated on the roof and back of the pharynx, by Loewenberg's forceps (Fig. 199) passed behind the palate. The pharyngeal tonsil which is usually hypertrophied in connection with adenoid growths can be readily removed by these forceps. No after-treatment, beyond compelling the child to breathe through the nose by keeping the mouth closed at night with a bandage, is usually required.

DISEASES OF THE PHARYNX AND ŒSOPHAGUS.

PHARYNGITIS, or inflamation of the pharynx, is commonly of the catarrhal variety (*acute and chronic pharyngitis*), but it may fall chiefly on the glands of the pharynx (*follicular or granular pharyngitis*), or, more rarely, may spread deeply and end in suppuration (*phlegmonous pharyngitis*). At times it is attended with deficient secretion and atrophy of the mucous membrane (*pharyngitis sicca*), and occasionally assumes an *erysipelatous* character and is then generally associated with erysipelas of the face. Here a few words only can be said on the *phlegmonous* form, which, perhaps, more commonly comes under the care of the general Surgeon. It is usually the result of an injury. The pharynx is intensely red and swollen, the neck often brawny and œdematous, swallowing is difficult or impossible, respiration is laboured, and death may occur in a few days from sudden spasm of the glottis, or from exhaustion and blood-poisoning. The *treatment* consists in inhalations of steam impregnated with carbolic acid; free incisions if pus forms in accessible situations; the administration of fluid nourishment and stimulants, in the form of enemata if the patient is unable to swallow; and the performance of instant tracheotomy if œdomatous laryngitis supervenes.

ULCERATION generally occurs in connection with like ulceration of the palate, fauces, and tonsils. (See *Tonsils.*) Here it need only be said that the healing of the ulcers, especially those of the tertiary syphilitic variety, is sometimes productive of great deformity. Thus, 1, the soft palate may become glued to the back of the pharynx or 2, to the base of the tongue; and 3, the lower part of the pharynx may be narrowed just above the entrance to the larynx, rendering deglutition difficult, and subjecting the patient to the risk of suffocation from the lodgment of food at the constricted part. *Treatment.*—

Adhesions between the palate and pharynx can hardly be remedied; but when contraction or *stenosis* of the lower pharynx has occurred, the cicatricial bands should be divided in a backward direction with a guarded knife and recontraction prevented by the daily passage of a bougie. I have found a Ricord's urethrotome answer admirably for making the division. If the introduction of instruments causes much spasm, tracheotomy should be previously performed.

POST-PHARYNGEAL ABSCESS is a collection of pus in the loose cellular tissue behind the pharynx, and is most often met with in children. It is generally chronic and due to disease of the cervical vertebræ or more rarely of the base of the skull; but it may be acute, and is then usually the result of an injury, as swallowing acids or the impaction of a foreign body, or of the exanthemata, phlegmonous pharyngitis, &c. It sometimes occurs without apparent cause; there is then often a history of syphilis or tubercle. It may break into the pharynx, or at the side of the neck, or even make its way into the mediastinum. *Symptoms*—Pain, difficulty in opening the mouth, obstructed deglutition and respiration, the presence of a fluctuating swelling at the back of the throat, and more or less swelling about the angle of the jaw. When the abscess is acute, there is commonly some febrile disturbance. *Treatment*—A vertical incision should be made in the middle line through the posterior pharyngeal wall with a properly guarded knife, the swelling having been previously punctured with a long grooved needle if there is any doubt as to its nature. If opened under chloroform, the head should be turned rapidly to the side to allow the escape of pus through the mouth, as suffocation has occurred through a sudden gush into the air-passages. When it depends upon disease of the spine, if an opening is thought necessary it should be made through the side of the neck.

TUMOURS OF THE PHARYNX are rare, though all varieties may occur. When arising in the loose cellular tissue behind the pharynx, the more common situation, they are spoken of as *post-pharyngeal* tumours, and closely simulate abscess. The absence of fluctuation, and of pus on puncture will settle the diagnosis. Innocent growths, when small and unattached to the vertebræ, may be enucleated through a vertical incision over them. The malignant, as a rule, should be left alone.

STRICTURE OF THE ŒSOPHAGUS may be due to spasm of the muscular fibres (*spasmodic stricture*), to cicatricial contraction (*fibrous stricture*), or to epitheliomatous or other malignant growths of its walls (*malignant stricture*). Further, stricture may be simulated by compression of the œsophagus from without as by an aneurism, enlarged thyroid gland, post-œsophageal abscess, or mediastinal tumour; or by a foreign body impacted in the tube, disease at the back of the larynx, &c.

Spasmodic stricture or *spasm of the œsophagus* generally occurs in young hysterical women. The patient may be quite unable to swallow, and a bougie, perhaps, will not pass. The *diagnosis* will then rest on the obstruction existing only at times; on the age and sex of the patient; the presence of other signs of hysteria; but chiefly on the fact that, under an anæsthetic, the bougie, which could not previously be passed, slips easily down into the stomach. The *treatment* should consist in the administration of anti-hysterical remedies; whilst the patient may be persuaded that the bougie has cleared the passage.

Fibrous stricture is generally due to cicatricial contraction following an injury, as swallowing boiling water or corrosive fluids, or the impaction of a foreign body. More rarely it results from the healing of a syphilitic ulcer. At times it appears to be congenital; at other times no cause can be discovered. It may exist at any part of the tube, but is most common in the upper half (Fig. 201.) It is much rarer than the malignant form, but is liable to become malignant when it has existed for some time. As the result of the constriction, the tube above the stricture becomes dilated and the muscular coat hypertrophied. The dilatation may be general or pouch-like, in the latter case consisting either of a dilatation of all the coats, or of a hernia of the mucous membrane through the muscular fibres.

Malignant stricture is generally epitheliomatous, and may occur at any part of the œsophagus, but is most common opposite the cricoid cartilage, at the bifurcation of the trachea, and at the cardiac end of the stomach (Fig. 202), situations at which normally slight obstruction to a larger bolus of food than usual exists, and at which "developmental processes are complicated, and where, therefore, errors of nutrition are more likly to occur." Thus, at the cardiac orifice tho epithelium changes its character; and where the œsophagus is crossed by the bronchus the food and air passages were originally one. Epithelioma may begin as a distinct cauliflower-like excrescence springing from one side of the tube; or as a nodular induration of the mucous membrane involving ring-like the whole calibre of the œsophagus. It gradually encroaches upon the lumen of the tube causing more or less complete obstruction. The growth sooner or later ulcerates, and invades the surrounding tissues, the mediastinum, pleura and glands; and sinuses may form between the œsophagus and the trachea or left bronchus, or open externally when the disease is high up in the neck. The patient, if he does not die of starvation, succumbs to pain or exhaustion, or to hæmorrhage from the laying open of a large vessel, or to pleurisy, or pneumonia.

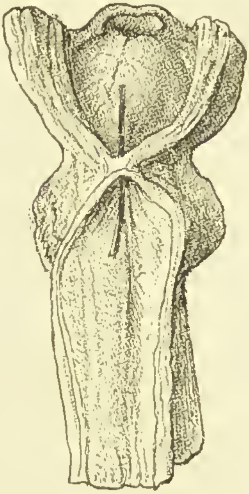


Fig. 201.—Fibrous stricture of œsophagus at region of cricoid cartilage. (St. Bartholomew's Hospital Museum.)

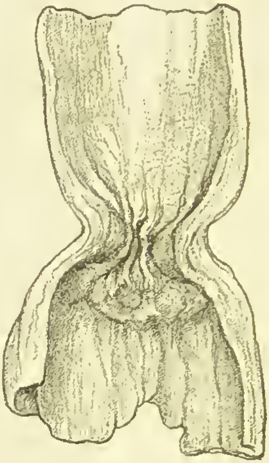


Fig. 202.—Malignant stricture of œsophagus at entrance of stomach. (St. Bartholomew's Hospital Museum.)

The *symptoms*, common to both the fibrous and malignant stricture, are,—1, increasing difficulty of swallowing, first of solids, then of liquids, and finally inability to swallow either; 2, a feeling of obstruction, generally referred to the top of the sternum; 3, regurgitation of food after it has been swallowed for a short time (where the stricture is low down or pouch-like dilatations have formed); 4, a trickling sound on auscultation between the shoulders whilst the patient is swallowing fluid, and 5, progressive wasting and loss of strength. The *diagnosis*, however, can only be made with certainty, and the situation of the stricture ascertained, by the passage of a bougie. But before attempting to pass a bougie, a careful examination of the chest should be made for the purpose of excluding aneurism as a cause of the symptoms, lest such should be ruptured, as has before now happened. The diagnosis of the malignant from the fibrous stricture will rest on the advanced age of the patient, the absence of any discoverable injury, the presence of blood or foul-smelling discharge on the end of the bougie, a sensation of passing over an ulcerated surface, and the presence of enlarged glands or an indurated mass in the situation of the tube when the stricture occurs in the neck.

Treatment.—In the *fibrous form* the stricture should be gradually dilated by bougies. When the stricture is very tight, a catgut bougie may sometimes by delicate manipulation be insinuated through it; and over this a larger tube may then be passed. When the stricture is very resilient its division posteriorly in the middle line may be called for (*internal œsophagotomy*). When the stricture is situated at the cardiac end, and a well directed trial at dilatation has failed, gastrotomy may be performed, and the stricture forcibly dilated by the finger or an instrument passed into the œsophagus from the interior of the stomach. It need hardly be said that so serious an operation should not be lightly undertaken, nor until other means have failed. In *malignant stricture* dilatation by bougies or tubes, in the way recommended in fibrous stricture, must not be attempted, as the walls of the œsophagus are so softened by the ulceration and disease that great danger of perforation and extravasation into the mediastinum or pleura would be incurred. The methods of treatment then open to us are—1, to pass an œsophagus tube and keep it *in situ*; 2, to perform gastrostomy; and 3, when the stricture occurs in the neck to open the œsophagus in the neck, if possible below the seat of stricture, and stitch the tube to the wound in the skin; or if not possible to get below the stricture, to dilate it from the wound. When a soft tube can be passed and kept *in situ*, this appears to be undoubtedly the best treatment. The tube may be introduced through the mouth or nose, and under favourable circumstances will not need changing for a month or more. Occasionally, however, it causes irritation of the back of the tongue or larynx, or of the mucous membrane of the nose. Should this occur, Mr. Charters Symonds' plan may be adopted of passing, by means of a suitable director, a short tube, shaped like a funnel at one end, into the stricture, and leaving it there merely attached by a strong string, which is secured to the cheek or ear by strapping (Fig. 203). Care must be taken that the patient does not swallow the string, an accident which has happened during this treatment. Excellent results have followed the use of tubes; patients have regained flesh, have fairly enjoyed life for some months, and then have died in comparative ease. When a tube cannot be passed, or is not tolerated, the œsophagus, if the disease is high in the neck, may be opened, or if the disease is low down, gastrostomy performed.

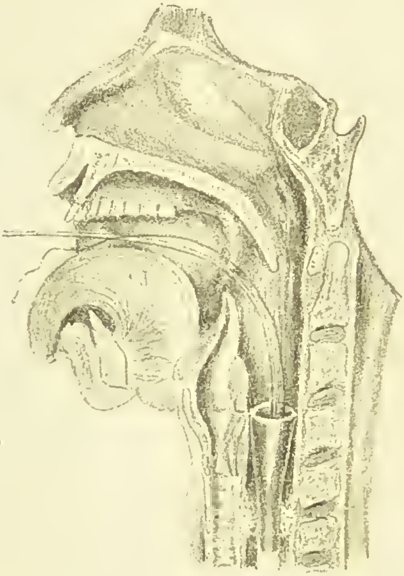


FIG. 203.—A Symonds' tube in situ.

GASTROSTOMY is the operation of establishing a fistulous opening into the stomach for the purpose of feeding the patient in stricture of the œsophagus. The operation is now usually performed in two stages. In the first, the abdomen is opened, and the stomach secured by suture to the abdominal parietes; in the second, which is not performed till from four to six days after the first, the stomach, which by this time has become adherent to the abdominal parietes, is punctured, and a tube introduced. 1. An oblique incision (Fig. 224, e) is made between two and three inches long, about an inch below, and parallel with the left costal cartilages, beginning about an inch and a half from the middle line (Howse). The sheath of the rectus is next opened, the fibres of the muscle separated, not cut, the posterior layer of the sheath divided, and the peritoneum exposed. Mr. Howse thinks that the fibres of the rectus subsequently play the part of a sphincter to the opening. All bleeding having been stopped, the peritoneal cavity is opened on a director, and the stomach sought and drawn into the wound if it does not already present there. It may be distinguished from the tranverse colon by its thick, smooth, and pinkish-red coat. Two loops of silk are passed through the peritoneal and muscular coat for the purpose of securing a good hold of the stomach whilst the sutures are being introduced, and also for the purpose of steadying it during the subsequent operation of opening it and thus preventing the risk of the adhesions being broken down. The stomach, as near the cardiac end as possible, is now stitched to the parietes by a double ring of sutures, so as to ensure a good inch of the stomach wall (that between the outer and inner ring of sutures) being in contact with the parietal peritoneum (Fig. 204). The outer ring of sutures is passed first, by carrying the needle, armed with a silk suture, through the serous and muscular coat of the stomach, and then through the abdominal parietes a good inch from the edge of the wound. The

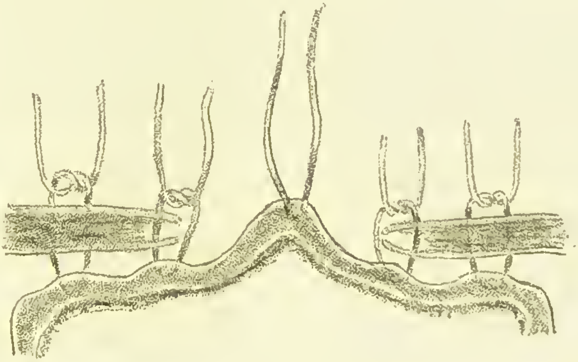


FIG. 204.—Howse's method of suture in gastrostomy.

needle is now unthreaded and withdrawn, re-threaded with the stomach end of the suture, and passed through the abdominal parietes, unthreaded, and finally withdrawn. When all the sutures are *in situ* they are tied over a quill. The inner ring of sutures are then passed through the serous and muscular coat of the stomach and the skin and peritoneum only of the parietes, and tied. The wound is dressed antiseptically. 2. At the end of from four to six days the stomach will generally be found adherent, and should then be punctured with a long sharp tenotomy knife, while it is drawn well forwards by the silk ligatures left in for the purpose. A No. 6 or 8 English catheter is passed through the puncture, and the wound again dressed antiseptically, the catheter passing through the antiseptic dressings. At first only teaspoonfuls at a time of fluid nourishment should be given; later a larger tube may be passed, and minced solid food introduced.

DISEASES OF THE LARYNX.

LARYNGITIS, or inflammation of the larynx, may be conveniently divided into acute catarrhal, chronic catarrhal, œdematous, and membraneous laryngitis.

Acute catarrhal laryngitis may be due to sudden exposure to cold or damp, violent exertion of the voice, or inhalation of noxious vapours or impure air; or the inflammation may spread to the larynx from the pharynx; or occur in the course of other diseases as the eruptive fevers. *Symptoms.*—Soreness of the throat, hoarseness or even aphonia, laryngeal cough, and tenderness on pressure over the thyroid cartilage, accompanied by febrile symptoms. On laryngoscopic examination the parts are seen red and swollen, and the cords do not come together properly. The *treatment* consists in rendering the atmosphere moist by the steam kettle, in inhaling soothing vapours, and abstaining from using the voice; whilst if the attack is very acute, leeches, or cold in the earlier stages, may be applied over the thyroid cartilage. Should the inflammation assume the œdematous form scarification, intubation, or tracheotomy may become necessary (see *Œdematous Laryngitis*).

Chronic laryngitis may be due to exposure to wet and cold, over-exertion of the voice, excessive smoking, inhalations of dust and vapours, syphilis, tubercle, and malignant disease. The mucous membrane appears thickened and indurated and covered with a mucopurulent discharge, whilst the glottis is narrowed in consequence of the thickening of the mucous membrane. *The symptoms* are cough, hoarseness, laryngeal voice, dryness and irritation of the throat, and dyspnœa, varying with the amount of narrowing of the glottis. A variety of chronic laryngitis, in which the mucous follicles are chiefly affected, is known as follicular or granular laryngitis, or clergyman's sore throat, and is frequently associated with a similar condition of the pharynx. *Treatment.*—The application with the brush of a strong solution of nitrate of silver (half a drachm to the ounce, or even stronger), absolute rest of the voice, residence at a suitable spa, avoidance of all sources of irritation, and appropriate remedies if there is any specific disease.

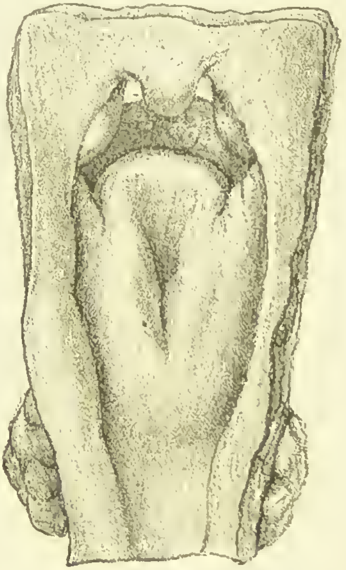


FIG. 205.—Œdematous Laryngitis. (St. Bartholomew's Hospital Museum.)

Œdematous laryngitis or œdema of the glottis.—In this form there is an effusion of serous fluid into the submucous tissue of the larynx, especially that about the aryteno-epiglottidean folds (Fig. 205). But the œdema does not extend below the vocal cords, as the mucous membrane is tightly attached to them without the intervention of any submucous tissue. *Cause.*—It generally comes on suddenly, and often supervenes upon some previous inflammatory condition of the larynx or neighbouring parts. It is of common occurrence after scalds or burns of the throat, stings of insects, or the impaction in the larynx of a foreign body; or it may occur in the course of such diseases as erysipelas, fevers, and small-pox; or be engrafted on tubercular or syphilitic ulceration of the larynx, perichondritis, or necrosis of the cartilage. Œdema of the larynx of a passive character is also a frequent termination of Bright's disease. The *symptoms* in the acuter forms are most urgent, the dyspnœa is extreme, and if not relieved rapidly ends in spasm and death. When less acute the voice is affected, inspiration is often stridulous and laboured, and swallowing is painful and difficult—symptoms which may be followed by cyanosis, coma, and death. The *treatment* must be energetic; an emetic should be given at the onset, and leeches, ice, or, if preferred, hot sponges, applied over the thyroid cartilage. These means failing, the œdematous part must be scarified by the laryngeal lancet, or an O'Dwyer's tube, if at hand, passed through the glottis, and retained there until the œdema subsides; otherwise laryngotomy or tracheotomy must be performed.

Membraneous laryngitis, laryngeal croup or laryngeal diphtheria, is a disease of childhood, and may either begin in the larynx, or spread to it from the fauces and pharynx. It is characterized by the formation of a false membrane, which may extend into the trachea and bronchi (Fig. 206). The membrane, which may be hard and tough, or soft and crumbling, and of a yellowish or greyish-white colour, is produced by the coagulation of fibrinous material exuded on the surface of the mucous membrane. It consists of a delicate network of fibres enclosing leucocytes, cast-off epithelium, and granular débris in its meshes. On its separation the mucous membrane beneath is generally though not invariably found to be denuded of epithelium, congested and inflamed; but the mucosa is not usually involved as is the case in diphtheritic inflammation of the fauces and pharynx. This difference would appear to depend on the site of the inflammation and the intensity of the process, though some consider it a point in favour of the non-identity of croup and diphtheria, a question however which cannot here be discussed. The *symptoms*, when the disease begins in the larynx, generally come on very gradually; and at first cannot be distinguished from an ordinary catarrh. Soon, however, and often first during the night, the cough acquires a ringing or brassy character, and soon afterwards, if not simultaneously, the inspiration becomes stridulous, and later the voice "hoarse, cracked, and whispering, or in young children totally suppressed." Dyspnœa is now marked; the soft parts of the chest-walls recede during inspiration; the inspiration is heaving; expiration as well as inspiration may also become impeded, and the child, if not relieved, rapidly becomes cyanosed and dies. When the disease spreads from the pharynx, the laryngeal signs may at first be masked; but later, they are similar to those given above. *Treatment.*—Internally quinine and perchloride of iron may be given, whilst locally when any membrane is visible on the fauces and pharynx it should be removed, and prevented, if possible, from reforming by swabbing out the throat at frequent intervals with boroglyceride, carbolic acid, or other disinfectant. The child may be placed under chloroform, if necessary, to ensure the thorough removal of the membrane. Should the larynx become obstructed, tracheotomy must be performed. The chief indications for this operation are 1, retrocession of the soft parts of the chest walls, 2, suppression of the voice, and especially 3, impeded expiration. Before introducing the tracheotomy-tube the membrane should be thorougly removed both from the trachea and larynx by a feather or by the suction-tube apparatus, and its re-formation if possible prevented by constant spraying of the part through the tube with an alkaline lotion. The patient's bed should be surrounded with

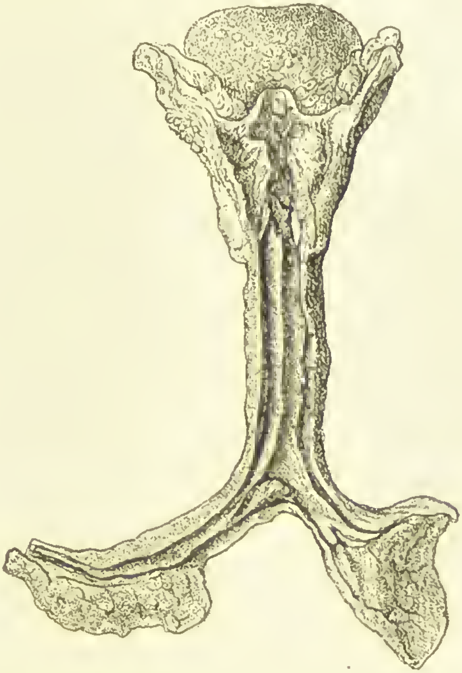


FIG. 206.—Membraneous laryngitis or croup.
(St. Bartholomew's Hospital Museum.)

curtains, and the atmosphere kept moist by steam to which an antiseptic is added. He should be fed with soft solid nourishment, and if necessary by a flexible silk tube passed through the nose. Stimulants are generally required. The recumbent posture should be insisted on, as there is grave danger, if the patient attempts to sit up, of sudden and fatal cardiac syncope.

Tubercle of the larynx, also called laryngeal phthisis, may sometimes occur as a primary affection, though it is generally secondary to tubercle of the lung. It is characterized by the formation of miliary tubercles under the mucous membrane, which subsequently break down, leading to ulceration. The *symptoms* are those of ordinary chronic laryngitis, but in addition to these, the patient often presents signs of pulmonary phthisis. On examination the mucous membrane looks pale, and the aryteno-epiglottidean folds swollen and often of a pyriform shape; later, ulceration will be discovered, and may be followed by caries and necrosis of the laryngeal cartilages, dysphagia, and œdema of the glottis. *Treatment.*—The usual constitutional treatment for tubercular diseases must be employed. When ulceration has occurred insufflation of morphia and painting the part with cocaine before taking food may be tried to relieve the cough and the difficulty and pain in swallowing. Should swallowing become impossible, the patient should be fed with the œsophageal tube whilst lying face downwards. Tracheotomy must be performed if suffocation threatens.

Syphilis of the larynx.—In the secondary stages of syphilis, catarrhal inflammation, superficial ulceration, and mucous patches may occur; whilst in the tertiary stages characteristic ulcers due to the breaking down of gummata are not very uncommon. Tertiary ulceration may extend to the perichondrium, or a gumma may begin beneath that membrane, and in either case lead to necrosis or caries of the cartilages. On the healing of the ulcers contractions and adhesions producing stenosis of the larynx may ensue. General syphilitic *treatment*, appropriate to the stage, should be employed. Scarification or tracheotomy are called for in tertiary affections should œdema of the glottis supervene. In *stenosis* an attempt may be made to dilate the contracted glottis by means of O'Dwyer's tubes, or the stricture may be divided with a guarded knife, or with the galvano-cautery.

Tumours both innocent and malignant occur in the larynx. Of the former the papillomata and fibromata are the most common, of the latter the epitheliomata. *The papillomata* occur as warty or pedunculated excrescences, or as soft, flocculent, villous-like bodies, and generally grow from the vocal cords and front of the larynx (Fig. 207).

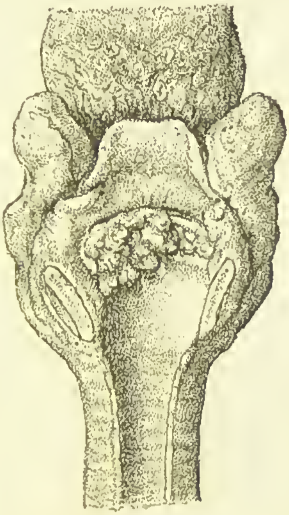


Fig. 207.—Papilloma of larynx. (St. Bartholomew's Hospital Museum.)

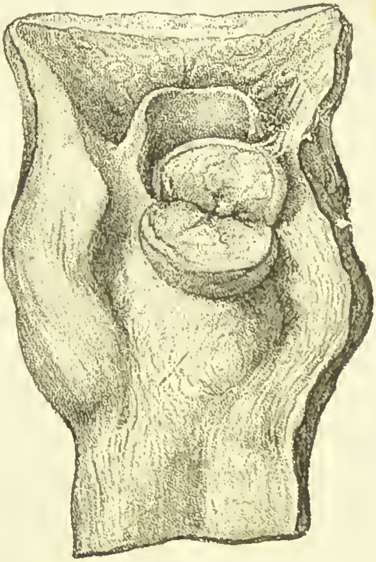


Fig. 208.—Sarcoma of larynx. (St. Bartholomew's Hospital Museum.)

They may be single or multiple. *The fibromata* are less common, and occur as small, smooth, solitary, spherical, pedunculated or sessile growths, springing from the vocal cords. *The epitheliomata* usually grow from the mucous membrane covering the arytenoid cartilages, or from the ventricular bands or cords. A sarcomatous tumour is shown in the accompanying illustration (Fig. 208).

The chief *symptoms* of a growth in the larynx are hoarseness or aphonia and dyspnœa. When the growth is pedunculated the symptoms are often paroxysmal and intermittent in character, in consequence of the growth being moved by the current of air in respiration. The laryngoscope is essential for the diagnosis. In the early stages it may be difficult to distinguish an innocent from a malignant tumour, but if a small piece can be removed, a microscopical examination will usually clear up the point. Later, the rapid growth of the tumour, its tendency to ulcerate, its induration, its involvement of surrounding parts, the enlargement of lymphatic glands, and the accompanying pain and cachexia will indicate malignancy. Frequently, however, the lymphatic glands are not involved, and there may be no cachexia.

Treatment.—Innocent growths should be removed if possible by the intralaryngeal method. This may be done by evulsion with the laryngeal forceps, or by excision with the cutting forceps, or with the cold wire or galvano-cautery snare, local anæsthesia being induced by cocaine. When of very large size, or broad-based, or situated below the cords, or in other parts where they cannot be removed by this method, laryngo-tracheotomy or thyrotomy may have to be performed. When a malignant growth is confined entirely to the larynx, and the glands of the neck are not involved, thyrotomy may still be performed, and the growth completely cut and scraped away from the cartilages, or if the cartilages are found invaded, part, or even the whole of the larynx may be extirpated. Otherwise palliative treatment only can be employed, or tracheotomy performed if suffocation threatens.

OPERATIONS ON THE AIR PASSAGES.

Under this head are included *tracheotomy*, *laryngotomy*, *laryngo-tracheotomy*, *thyrotomy*, *subhyoid pharyngotomy*, and *intubation* and *extirpation of the larynx.* Tracheotomy, laryngotomy, and laryngo-tracheotomy, may be required, 1, for establishing a permanent opening below an obstruction of the larynx; 2, as a temporary expedient until such an obstruction can be removed; 3, for the extraction of a foreign body or growth; and 4, to prevent blood entering the trachea during operations about the mouth, jaw, tongue, and pharynx. Thyrotomy and subhyoid pharyngotomy may be necessary for the removal of a growth or foreign body when such cannot be extracted by the intralaryngeal method or by one of the former operations. Complete or partial extirpation of the larynx may have to be undertaken for a malignant growth confined to the larynx. Before performing any of these operations the Surgeon should consider well the anatomy of the middle line of the neck. Beginning at the chin is the raphé between the mylo-hyoid muscles, next the hyoid bone, then the thyro-hyoid membrane through which an incision is made in the operation of *subhyoid pharyngotomy* (Fig. 209, a). Below this is the pomum Adami, or the notch in the thyroid cartilage, which though prominent in adults, especially in males, can hardly be felt in the fat neck of a child. An incision exactly in the middle line through the thyroid cartilage is known as *thyrotomy* (Fig. 209, b). A little below the thyroid cartilage the cricoid can be felt. It is situated opposite the fifth cervical vertebra, and is an excellent landmark, as it can always be distinguished

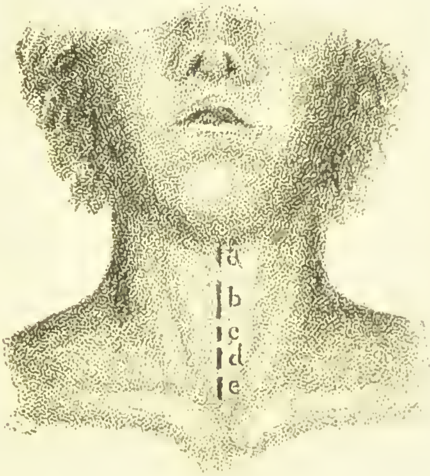


Fig. 209.—Incisions for operations in middle line of neck. a. Subhyoid pharyngotomy. b. Thyrotomy. c. Laryngotomy. d. Tracheotomy above isthmus. e. Tracheotomy below isthmus.

however fat the neck. Between it and the thyroid cartilage is the crico-thyroid membrane, which is quite superficial being covered only by the skin, superficial and deep fascia, and the overlapping sterno-hyoid muscles. This is the spot where *laryngotomy* is performed (Fig. 209, c). Below the cricoid cartilage are two or three rings of the trachea, and then the thyroid isthmus. There is usually a space between the cricoid cartilage and the isthmus of a quarter to half an inch Here the trachea is merely covered by the skin, superficial and deep fascia, and the overlapping sterno-hyoid muscles on either side, and it is in this situation that *tracheotomy* is best performed (Fig. 209, d). When the incision is extended upwards through the cricoid as well as through the upper rings of the trachea, it is called *laryngo-tracheotomy.* After the isthmus of the thyroid gland, which, in adults, is usually about half an inch wide, follow four or five rings of the trachea, and then the upper border of the sternum. Below the isthmus the trachea recedes from the surface, and in addition to the skin and superficial and deep fascia, is covered by the sterno-thyroids as well as the sterno-hyoids, and by two layers of deep fascia between which is the large inferior thyroid plexus of veins. Superficial to the muscles, the anastomotic branch between the anterior jugular veins also crosses the trachea. On the trachea itself are several small branches from the inferior thyroid arteries, and sometimes the thyroidea ima, an abnormal branch coming off from the aorta; whilst, rarely, the innominate vein may be higher than usual, and cross the trachea above the level of the sternum. On either side of the trachea low in the neck are the carotid arteries. Some Surgeons perform tracheotomy below the isthmus (Fig. 209, e); but a review of these anatomical relations makes it evident how much greater is the risk and difficulty then attending it.

TRACHEOTOMY may be performed either above or below the thyroid isthmus. The former situation should, as a rule, be chosen, as here the operation can be performed with greater ease and less risk. Moreover, there is less danger of suppuration extending between the layers of the cervical fascia which are necessarily opened if the low operation is done. In favour of the low operation, on the other hand, it is argued that the opening is further from the disease when the larynx is affected, and nearer to the bronchi when a foreign body has to be extracted; and that there is more room than above the isthmus, as the latter sometimes touches the cricoid cartilage. The isthmus, however, can be drawn downwards quite easily with blunt hooks, or, if necessary, may be divided in the middle line with perfect safety and practically no hæmorrhage. If there be any advantage in the low operation in that the trachea is opened further from the disease, it is, in my opinion, fully compensated for by the less risk attending the high operation.

The *high operation* only will be here described. It may be done either with or without chloroform. Chloroform should, as a rule, be given to children, as otherwise their struggles are apt to embarrass the operator. In adults, however, it is not necessary, as after the skin incision has been made no pain is felt, and chloroform is liable to increase the dyspnœa, if present, to a dangerous extent and necessitate the operation being rapidly performed, whereas the more deliberately it can be done, the less are the risks attending it. A small pillow having been placed beneath the neck so as to render it prominent, make an incision from the cricoid cartilage, exactly in the middle line, for an inch and a half to two inches downwards according to the age of the patient, fatness of the neck, &c. (Figs. 209 and 213, d). Divide the skin and superficial fascia, and having found the interval between the sterno-hyoid muscles continue your incision between them, carefully avoiding any large veins. The isthmus of the thyroid will now be seen in the lower part of the wound as a bluish-red body; and if sufficient room does not exist between it and the cricoid cartilage, draw it down gently with a blunt hook; or if this cannot be readily done, notch it in the middle line or divide it. The drawing downwards of the thyroid is greatly facilitated by dividing the layer of fascia which extends from the cricoid cartilage to the isthmus, transversely on the cricoid. By doing this, moreover, the wounding of the veins between the layers of fascia will be avoided. The first two or three rings of the trachea having now been fully exposed, and all arterial hæmorrhage arrested by ligature or pressure-forceps, thrust the sharp hook into the trachea immediately below the cricoid cartilage, and steadying it in this way, divide the first two or three rings by thrusting in the knife with the back of the blade directed downwards and by cutting towards the cricoid. Venous hæmorrhage, except from a large vein, which of course should be tied, need not delay the opening of the trachea, as it depends on the overful right side of the heart, and will disappear after two or three full inspirations through the tracheal wound. The wound in the trachea being held open by the tracheal dilator, pass the outer tube, made wedge-shaped by pressing it between the finger and thumb, into the trachea, and then immediately insert the inner cannula, as until this is done, air cannot freely pass through the tube. Secure the tube *in situ* by tracheotomy tapes tied behind the neck. Where the operation is performed for croup or diphtheria, the tube should not, as a rule, be inserted at once, but the wound held open by the dilator, and any false membrane removed by a feather passed both down into the trachea and up into the larynx, or if this does not succeed, by a Parker's suction-tube apparatus. The bivalve cannula in general use, is apt, on account of its shape, to produce ulceration of the anterior wall of the trachea, on which from its curve it must necessarily impinge, and has even been known to perforate the wall and to enter the innominate artery. This can be prevented by the improved-shaped cannula invented by Mr. R. W. Parker (Fig. 210). Should the breathing cease during the operation, the trachea should still be opened, the obstructing membranes removed, and artificial respiration persevered in for some time.

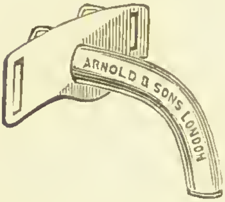


Fig. 210.—Parker's cannula.

Dangers and difficulties of the operation.—Where the operation can be done deliberately, and on a patient with a thin neck, it is attended with no great difficulty; but where, as is frequently the case, it has to be undertaken on an emergency, possibly with insufficient light and with no skilled assistant at hand, or on a young child or infant with a fat neck, and has to be completed rapidly to prevent death from suffocation, it is perhaps one of the most trying that the Surgeon is called upon to perform. The dangers into which the inexperienced and unwary may then fall are the following:—

1. *The hyoid bone or the thyroid cartilage* may be mistaken for the cricoid cartilage, and the incision made through the thyro-hyoid membrane or into the thyroid cartilage. This mistake could hardly occur except in a fat-necked child, and then only through carelessness in not determining the position of the cricoid cartilage before beginning the operation.

2. *The interval between the sterno-hyoid muscles may be missed*, and the dissection carried to one or other side of the trachea. The thyroid body and even the carotid artery has in this way been wounded. To avoid such a disaster the head should be held perfectly straight and the incision made accurately in the middle line; one side of the wound should not be retracted more than the other; and the index finger should be used from time to time to make sure that the dissection is being made over the trachea.

3. *Too short an incision may be made*, and consequently

be a source of embarrassment in drawing down the thyroid isthmus, and in defining the trachea before it is opened. The incision should never be less than an inch and a half long even in a child.

4. *One or more large veins may be wounded*, and the steps of the operation be considerably impeded by hæmorrhage. Their walls are very thin, great care therefore is necessary to avoid injuring them.

5. *The knife may perforate the posterior wall of the trachea* and enter the œsophagus. Caution, therefore, is necessary, and some advise that the knife should be held, whilst incising the trachea, with the forefinger placed half an inch from its point, so that it cannot penetrate too deeply.

6. *The knife may slip to one side*, instead of entering the trachea. This can hardly happen if the trachea is fixed by the sharp hook and drawn well forward into the wound whilst being perforated.

7. *The innominate vein, and even the innominate artery, have been wounded* in incising the trachea during the performance of the low operation. The knife, therefore, should be introduced with the back of the blade towards the sternum, and the incision made from below upwards.

8. *Blood may enter the trachea*, and if allowed to remain there will coagulate, and the clots being drawn into the bronchi and acting as plugs may cause suffocation. This danger should be guarded against by tying all bleeding vessels, and thoroughly exposing the trachea before incising it, lest there should be a vessel in front of it. Should only a little blood enter the trachea, it can be coughed up; but if the amount is large, the patient should be turned on his side, and the head depressed, the wound of course being held open by retractors, to allow it to run out; or if this does not suffice, an attempt must be made to remove it by suction. When there is a general oozing of blood from the wound, the introduction of the tube will prevent more escaping into the trachea.

9. *The tracheotomy tube may be forced between the fascia and the front wall of the trachea; or one valve of the tube may be passed inside the trachea, and the other outside.*—To escape these accidents, the incision in the trachea should be free, and its edges well retracted, or one edge may be held up by a sharp hook. To ensure both valves

entering the trachea, they should be pressed well together; this may be conveniently done by Sankoy's forceps (Fig. 211).

10. *The tube, in the case of croup may be passed between the tracheal wall and the false membrane*, a danger that may be guarded against by removing the membrane before introducing the tube.

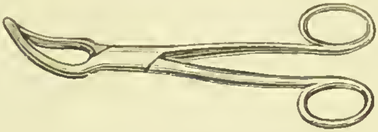


Fig. 211.—Sankey's forceps for introducing tracheotomy tube.

11. *The tube has been passed upwards into the larynx instead of downwards into the trachea.* No excuse, and it is to be feared no remedy, could be found for such gross ignorance.

After-treatment.—The room should be kept at a uniform temperature, and the air rendered moist by means of a steam-spray apparatus, and the bed well surrounded with curtains. The inner tube, especially if the operation is performed for diphtheria or croup, should be freed at frequent intervals with a feather, or with a small sponge fixed on a wire; and well cleansed by the nurse at least two or three times a day. The outer tube which also requires cleansing once a day, should only be removed by the Surgeon himself. Where it is necessary that a tube should be worn for any length of time, Mr. Morrant Baker's india-rubber cannula should be substituted for a silver tube. I have employed this immediately after the operation, but it is perhaps safer not to do so until the wound has been dilated for a few days by the silver cannula, as at first the resiliency of the tracheal rings tends to close the wound, and the india-rubber has been found in some instances not sufficiently stiff to resist their pressure. The pilot shown in Fig. 212, inasmuch as it renders the end of the tube stiff and wedge-shaped, facilitates its introduction. The india-rubber tubes may be worn with the greatest comfort, and for prolonged periods. I have now a patient who has worn them for upwards of four and a half years. When lined with canvas, as suggested by Mr. Baker, the tube will last in very good condition for nearly twelve months. If a silver tube be worn it should be examined on each removal, any blackening of the end, and, of course, the presence of blood being an indication that ulceration is in progress. The tube should only be worn as long as respiration through the glottis is impeded. To determine when the tube may be dispensed with it is only necessary to close the wound with the finger and thus test the breathing. As a rule, it is better to remove the tube at first only during the day, or for a few hours at a time, or where a fenestrated cannula is used the external opening may be stopped for certain periods with a plug to gradually accustom the patient to breathe through the glottis. When the tube has been worn for any length of time some difficulty is often experienced in leaving it off. This may depend chiefly on: 1. the formation of granulations in the trachea above the opening for the tube; 2. adhesions of the vocal cords to one another; and 3, paralysis complete or partial of the intrinsic muscles of the larynx. Where granulations are the cause of the obstruction, they should be touched at intervals with nitrate of silver. Where there is adhesion of the vocal cords the glottis may either be dilated by O'Dwyer's tubes, or the adhesions broken down by probes passed up through the wound or down through the mouth. The power of the muscles may be restored by galvanism, one pole being placed in the larynx, and the other over the situation of the recurrent laryngeal nerve. In children the condition improves as they grow older, and the larynx becomes more developed.

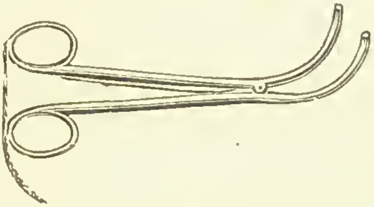


FIG. 212.—Author's pilot for Mr. Morrant Baker's soft tube.

LARYNGOTOMY.—Feel for the cricoid cartilage, and if the case is urgent, and the patient evidently *in extremis*, plunge a penknife through the skin and subjacent crico-thyroid membrane transversely, immediately above the cricoid cartilage, and hold the wound open by a hair-pin, piece of wire from a champagne bottle, &c. When the operation can be done deliberately, make an incision exactly in the middle line of the neck from a little above the lower border of the thyroid cartilage to a little below the upper border of the cricoid cartilage (Figs. 209 and 213, c), and the crico-thyroid membrane having been thus exposed, incise it transversely, introducing the knife immediately above the cricoid cartilage, so as to be as far as possible from the vocal cords, and in order to avoid wounding the little crico-thyroid artery which anastomoses with its fellow usually across the upper part of the space. This artery, though commonly so insignificant in size that any hæmorrhage from it could be readily controlled by the tube, is sometimes of considerable dimensions, and, if then wounded, would require tying. The laryngotomy tube should be somewhat compressed from above downwards, so as better to correspond with the shape of the crico-thyroid space. Some Surgeons recommend that the incision through the crico-thyroid membrane should be vertical as the anterior jugular vein and the crico-thyroid

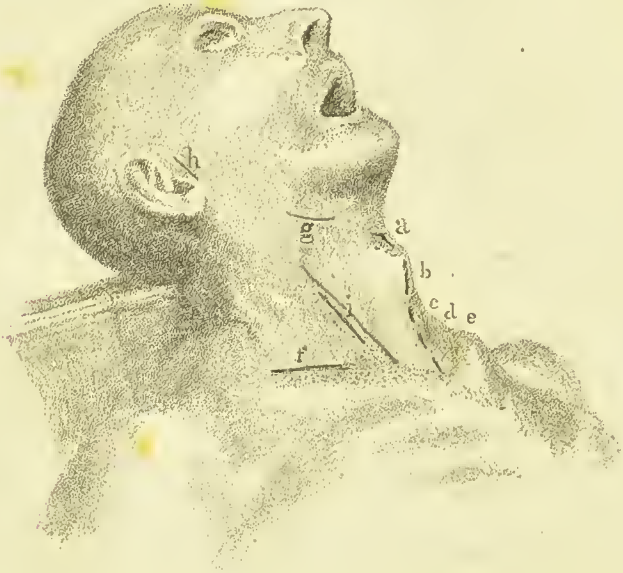


Fig. 213.—Incisions in certain operations on the neck. *a.* Sub-hyoid pharyngotomy. *b.* Thyrotomy. *c.* Laryngotomy. *d.* Tracheotomy above, and *e* below, the isthmus of thyroid. *f.* Ligature of sub-clavian (3rd part). *g.* Ligature of lingual. *h.* Ligature of temporal. *i.* Ligature of common carotid.

muscles have been injured in making the transverse incision, and an aërial fistula has at times remained after the latter has been employed. Further the vertical incision has this advantage, that it can be prolonged downwards through the cricoid cartilage if more room is required.

LARYNGO-TRACHEOTOMY consists in prolonging the incision in the trachea through the cricoid cartilage. It is sometimes done when there is not room between the cricoid cartilage and the isthmus for the performance of tracheotomy; also for the purpose of removing a growth from the larynx. Although no harm may follow the division of the cricoid, it should be avoided, if possible, as the integrity of the larynx is thereby interfered with, and serious impairment of the vocal apparatus has been the result.

Comparison of the operations of tracheotomy and laryngotomy.—Laryngotomy is a much easier operation and can be done with greater rapidity than tracheotomy. For this reason, it is *par excellence* the one to be undertaken on an emergency, as, for instance, threatened suffocation from the impaction of a portion of food at the entrance of the larynx. In children tracheotomy, or, in the case of an emergency, laryngo-tracheotomy, should always be undertaken, as the crico-thyroid space in them is too small to admit a tube. In adults, when either laryngotomy or tracheotomy can be performed deliberately, the opinions of Surgeons are somewhat at variance as to which operation ought to be undertaken for the varying conditions calling for an opening into the air-passages below the glottis. For my own part I always do tracheotomy, except in cases of emergency, as this operation does not interfere with the integrity of the larynx; whereas after laryngotomy the voice has at times been lost or impaired owing to contraction of the crico-thyroid membrane, or inflammation of the crico-thyroid joint or crico-arytenoid joint. Further there is often difficulty with the tube. This opinion, however, is not held by all. Thus, according to Mr. Erichsen, *laryngotomy* should be performed in: 1. Acute œdematous laryngitis. 2. Membraneous laryngitis in adults. 3. Chronic syphilitic and ulcerative laryngitis. 4. Tumours and foreign bodies obstructing the larynx. 5. Scalds and injuries of the larynx by acids. 6. Accidents during operations about the head and face in which blood accumulates in the larynx; and 7. Laryngeal spasm and paralysis from compression of the recurrent nerve. *Tracheotomy*, on the other hand, should be done for: 1. Membraneous laryngitis in children; 2. Foreign bodies in the trachea or bronchi; 3. Impaction of foreign substances in the larynx; 4. Necrosis of the cartilages with obstructive thickening of the tissues; and 5. As a preliminary to certain operations attended with hæmorrhage about the face or mouth.

THYROTOMY, or laying open the larynx from the front by dividing the thyroid cartilage in the middle line, may be required for the removal of a tumour or a foreign body impacted in the larynx after a thorough and careful attempt has been made to extract it by the natural passages (*intralaryngeal method*). Make an incision accurately in the middle line of the neck from the hyoid bone to the cricoid cartilage (Figs. 209 and 213, b), and, having exposed the thyroid cartilage, and stopped all bleeding, divide it along the angle formed by the junction of the alæ, taking care to do so in the middle line so as not to injure the vocal cords. Separate the alæ, and remove the growth, &c., and bring the alæ accurately together again, and unite them by silver wire or kangaroo-tail-tendon sutures, which should not, however, be passed through the whole thickness of the cartilage. When the removal of the growth is likely to be attended with hæmorrhage, tracheotomy should first be performed and the trachea plugged by Hahn's cannula.

SUBHYOID PHARYNGOTOMY consists in opening the pharynx through the thyro-hyoid membrane (Figs. 209 and 213, a), for the purpose of removing a tumour or impacted foreign body at the entrance, or in the upper part of the larynx. It is so rarely required that the steps of the operation are not given in detail here.

INTUBATION OF THE LARYNX, consists in passing a properly-shaped tube through the glottis by means of a forceps or pilot invented for the purpose. The tubes now used are those known as O'Dwyer's. It is employed as a substitute for laryngotomy or tracheotomy in certain cases, as œdematous laryngitis, membraneous laryngitis, &c.

EXTIRPATION OF THE LARYNX.—Partial or complete removal of the cartilages of the larynx may be required for malignant disease when the growth is confined to that organ and the glands in the neck are not involved. First perform tracheotomy, and plug the trachea with Hahn's tampon cannula, and continue the administration of the anæsthetic through it. Next make an incision in the middle line of the neck from the hyoid bone to the tracheotomy wound; free the upper part of the trachea and the larynx from their attachments by dissecting close to these structures, securing all bleeding vessels as they are divided. Divide the trachea above the cannula and detach the larynx from the remaining connections, working from below upwards. Where part of the larynx can be saved, the risks of the operation will be greatly lessened. Lightly plug the wound with iodoform gauze, leaving the cannula *in situ*. The patient must be fed at first through a soft tube passed down the œsophagus, and by nutrient enemata. On the healing of the wound an artificial larynx should be fitted to the parts, by the help of which the patient will be able to speak moderately distinctly.

DISEASES OF THE PAROTID GLAND.

PAROTITIS OR MUMPS, is an acute infectious disease attended with sharp febrile disturbance, and with a local inflammation of the parotid gland. There is generally much pain and swelling, but neither redness nor tendency to suppuration. On the subsidence of the inflammation in the one gland, the opposite, if not already affected, generally becomes inflamed, or more rarely the testicle, ovary, or mamma is attacked—a condition spoken of as metastasis. Confinement to the house, a gentle laxative, and a belladonna or opiate liniment to soothe the pain is all that is usually required.

PAROTID TUMOURS may begin in the parotid gland itself, or, as is perhaps more often the case, in one of the lymphatic glands situated over it. They have a great tendency to displace or destroy the parotid, and to extend deeply amongst the important structures behind the ramus of the jaw, where they may surround the carotid arteries, or even encroach upon the pharynx. In structure they may be fibrous, myxomatous, cartilaginous, sarcomatous or carcinomatous. The tumour, however, most common in the parotid region consists of cartilage intermixed with fibrous tissue, with atrophied glandular elements, and often with mucous tissue. The cartilage which so frequently exists in parotid tumours is believed to be derived from the elements of the rudimentary fœtal structure concerned in the development of the lower jaw, and known as Meckel's cartilage. Cysts are very rare, but cystic degeneration of the solid tumours is not infrequent.

Symptoms and Diagnosis.—The differential diagnosis of the various parotid tumours cannot be here attempted. Nor is it of consequence, as it is often impossible before removal to determine their exact nature. The practical points for the Surgeon to consider are :—Is the growth innocent or malignant, and can it be safely removed? *Innocent tumours* grow slowly, and are at first freely movable, smooth or slightly lobulated, circumscribed, hard and firm or semi-elastic; but as they increase in size they may become soft or fluctuating in places, either from mucoid softening or cystic degeneration. The skin over them, though stretched and thinned, is non-adherent, and the glands are not affected. *Malignant tumours*, on the other hand, grow rapidly, are ill-defined in outline, generally soft or semi-fluctuating, and become firmly fixed to the surrounding parts; the skin is adherent, purplish-red, brawny, infiltrated with the growth, and later ulcerated; and the lymphatic glands are enlarged. An innocent tumour, however, after having grown slowly for many years may suddenly take on a rapid growth and malignant characters.

Treatment.—When the tumour appears innocent, of moderate size, and freely movable, indicating that its attachments are not deep, there can be no question about its excision. But when of very large size, especially if firmly fixed to surrounding parts, or if malignant, unless quite small and the skin and glands are not to any extent involved, it should be left alone. *The Operation.*—Make a free longitudinal incision through the skin and fascia to thoroughly expose the tumour; it will then often readily shell out of its capsule; if not, draw it forward with vulsellum forceps, and separate its deeper attachments with the handle of the scalpel and occasional touches of the knife, the edge of which should be turned towards the tumour to avoid the branches of the facial nerve and other important structures. The proximity of the carotids should not be forgotten.

DISEASES OF THE THYROID GLAND.

BRONCHOCELE, GOÎTRE OR DERBYSHIRE NECK is an enlargement of the thyroid gland. It may be due, as is commonly the case, to the simple hypertrophy of the normal tissues of the organ (*ordinary goître*), and may then involve the whole gland or one of the lateral lobes, or only the isthmus. In other instances the hypertrophy may fall chiefly on the fibrous tissue constituting the septa of the gland (*fibrous goître*). Or along with some amount of simple hypertrophy, or of increase of fibrous tissue, one or more of the normal alveolar spaces may become enlarged, forming single or multiple cysts (*cystic goître*). Such cysts contain when single a serous fluid, or when multiple a colloid or a dark grumous material sometimes mixed with altered blood; whilst occasionally proliferating growths project into their interior from the cyst-walls. In other instances again, but more rarely, the hypertrophy is associated with a great increase in the vessels, and a forcible and expansile pulsation is given to the gland (*pulsating goître*). But the tissues besides hypertrophy may undergo secondary changes. Thus calcification may occur, and the enlarged gland become in places of stony hardness (*calcified goître*), or the fluid normally contained in the alveolar cavities may assume a colloid character. Lastly, the enlargement of the thyroid may be due to malignant disease (*malignant goître*). Goître in certain districts is endemic, especially in the Rhone Valley in Switzerland, and in Derbyshire, and is then frequently associated with the condition known as cretinism. It also occurs sporadically; and in some cases again is accompanied by a peculiar jerking beat in the carotids, by anæmia, and by a prominence of the eyeballs (*exophthalmic goître*) for a full account of which a work on Medicine must be consulted.

The *Symptoms* common to any form of enlargement of the thyroid is a swelling taking more or less the characteristic shape of the thyroid gland, and moving with the larynx in deglutition. In this country the enlargement is generally moderate; but sometimes, and especially in Switzerland, the goître forms a large mass hanging down in front of the neck, and may press upon or even displace the trachea and œsophagus. It occurs chiefly in women. In the ordinary variety it feels soft, semi-fluctuating, and of uniform consistency; in the cystic, one or more fluctuating places can be felt; whilst in the fibrous it will be firm and hard and more or less lobed or irregular; and where calcification has taken place of stony hardness. Malignant goître, which is very rare, may be known by rapid growth, enlarged glands, and the other signs of malignancy mentioned at page 62.

The *Cause* of endemic goître is not known. It has been attributed to impure water, water from limestone, and snow water, but without conclusive evidence. It is said to be most prevalent in valleys where from their direction the sun does not penetrate, on damp soil, and in damp parts of towns, but according to Mr. Berry these influences have little or nothing to do with its causation. In sporadic cases, heredity, disturbance of the sexual functions, and conditions producing congestion of the head and neck, are given as causes.

Treatment.—Sporadic cases of ordinary goître should be treated by the internal and external application of iodine. The application of biniodide of mercury ointment, followed by exposure to a hot sun, has been attended with much success in India. Injection of iodine and perchloride of iron is also recommended, but is not unattended with danger, as sudden death has occurred either from the accidental entrance of air or injection of iron or iodine into a vein. In cystic goître perchloride of iron is by some Surgeons recommended to be thrown into the cyst through a cannula, and the cannula plugged and allowed to remain for some days to set up suppuration. The cyst is then allowed to granulate from the bottom. For my own part I prefer laying the cyst open and draining it with antiseptic precautions. Where great dyspnœa has threatened suffocation, the gland has been removed; but since it has been shown that such removal is productive of myxœdema or a condition like it (*strumapriva*), it is a question whether complete removal is ever justifiable. It is better to divide the isthmus in the middle line for the purpose of freeing the trachea, or to remove the isthmus or one lobe of the gland, when the rest will generally shrink. *Endemic goître* admits of little treatment other than removal of the patient from the goîtrous district. For the treatment of *exophthalmic goître* see a work on Medicine.

Acute goître.—Goître, though usually chronic, sometimes occurs in an acute form, the gland increasing to the size of an orange in a few days, and causing severe. or it may be fatal, dyspnœa, from pressure on the trachea in consequence of the enlargement taking place so rapidly that the fascia of the neck has not time to yield. It occurs in young subjects both sporadically and endemically. In these instances it sometimes makes its way behind the sternum, so that it is difficult to get below it, even if tracheotomy is performed. The cause of the dyspnœa before the operation may not be very evident. *Treatment.*—The pressure may sometimes be removed by simply incising the fascia of the neck. Or tracheotomy may be done, and a long tube passed down the trachea beyond the obstruction; or the isthmus, or one lobe, may be excised. The patient, in the meanwhile, should be removed from the goîtrous district.

DISEASES OF THE SPINE.

SCOLIOSIS OR LATERAL CURVATURE is a complicated distortion in which the spine forms two or more lateral curves with their convexities in opposite directions, whilst the vertebræ involved in the curves are rotated on their vertical axes so that the spinous processes are directed towards the concavity of the curves.

Cause.—The immediate cause that underlies the formation of lateral curvature is the *unequal compression of the intervertebral cartilages for long periods.* This unequal compression may be induced by 1, any condition causing permanent or habitual obliquity of the pelvis and the consequent throwing of the spine over to the opposite side; such as unequal length of the legs, knock-knee, flat foot, the use of a wooden leg, habit of standing on one leg, sitting crosslegged, congenital dislocation of the hip, &c.; 2, a one-sided position of the body in sitting, standing, or lying, or produced by certain employments, as nursing or carrying with one arm, &c.; 3, contraction of one side of the chest following empyema; 4, unilateral contraction of the spinal muscles following paralysis of the opposing muscles. The conditions mentioned under 1 and 2 are, however, by far the most frequent causes of the deformity. Although lateral curvature may be induced by these causes acting alone, there are certain circumstances that appear especially to predispose to the deformity, by producing a general want of tone in the muscles and structural weakness of the ligaments and bones. Such are, 1, heredity; 2, general debility; 3, the strumous diathesis; 4, rickets; and 5, rapid growth. It is much more frequently met with in girls than in boys, and is most common about the age of fourteen to eighteen.

Pathology.—The long-continued unequal compression of the intervertebral cartilages causes them to become wedge-shaped, and the portion of the spine corresponding to the compressed cartilages to assume sooner or later a permanent lateral curve. Whilst, however, a curve is thus being produced, say, in the dorsal region with its convexity to the right, a compensating curve in order to maintain the equilibrium of the spine is being simultaneously produced in the lumbar region with its convexity to the left (Fig. 214). Coincidently with these changes a rotary movement of the affected vertebræ upon their vertical axes is taking place, so that while the bodies turn towards the convexity of the curve the apices of the spinous processes turn towards the concavity. Hence, in addition to the formation of the primary and the secondary or compensating curves, we have a twisting round of the spine within these curves, as a consequence of which the ribs on the convex side are carried backwards with the transverse processes, causing the angle of the

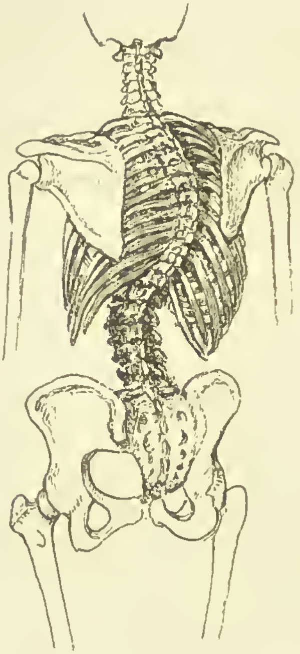


Fig. 214.—Lateral curvature of the spine.
(St. Bartholomew's Hospital Museum.)

scapula on that side to project; whilst the ribs on the concave side are for the same reason carried forwards, producing a prominence of the corresponding breast (Fig. 215). The cause of the rotation has been variously explained. The theory, perhaps, most generally accepted is that of Dr. Judson, who believes that the rotation is due to the fact that the posterior portion of the vertebral column, being a part of the dorsal parietes of the chest and abdomen, is confined by the ligaments and muscles to the median plane of the trunk; whilst the anterior portion projecting into the thoracic and abdominal cavities, being devoid of lateral attachments, is free to move either to the right or left of the median plane when the spine is inclined to either side. At first the bones are not affected, but when the compression of the cartilages has become permanent the bodies of the vertebræ also gradually assume a wedge shape, whilst the articular processes become contracted and flattened on the concave side and elongated on the convex. The ligaments and muscles on the concave side are shortened and atrophied, whilst on the convex side the ligaments are stretched and the muscles become hypertrophied.

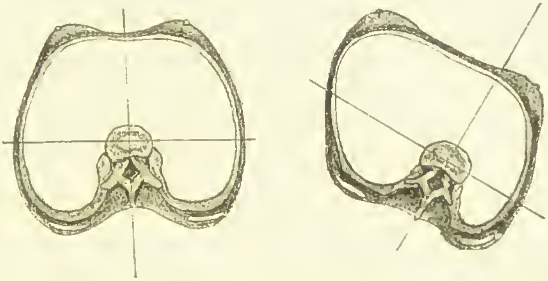


FIG. 215.—To show the effect of rotation in lateral curvature of the spine.

Signs.—Pain or a feeling of weakness in the back, general lassitude, and a stooping gait are amongst the early symptoms; but the patient is generally first brought for consultation on account of a slight projection of the scapula, or an apparent prominence of the iliac crest—a growing out of the shoulder or of the hip, as it is popularly termed. In slight cases there may be little or no lateral deviation of the apices of the spinous processes, and the little there is may be made to disappear on suspending the patient or placing her in the prone position.

In the severer cases, however, the signs are unmistakable. Thus, in the more common forms, there is usually a dorsal curve with its convexity to the right, and a shorter lumbar, or dorso-lumbar curve, with its convexity to the left. The right shoulder is generally elevated, and the angle of the right scapula, right iliac crest and left breast are prominent, whilst the left lumbar muscles, in consequence of the backward projection of the left lumbar transverse processes, stand out as a prominent ridge and give a greater sense of resistance on pressing over them than normal. In other cases the compensating curves may be so slight that there is apparently a single curve only, with its convexity either to the right or left, involving the whole spine or chiefly the upper dorsal or the lumbar vertebræ, and producing more or less projection of the scapula or apparent prominence of the iliac crest, &c., according to its severity and situation.

Treatment.—Where there is evidence of general or muscular debility the health and muscular tone should be improved by suitable remedies, the avoidance of late hours, fatigue and the like; whilst the exciting cause of the curvature should be looked for and if possible removed. In slight cases, the above means, when conjoined with a judicious selection of muscular exercises and partial recumbency, will generally serve to cure or improve the curvature, or at least prevent it from getting worse. But in severe cases, when osseous changes are already confirmed, some form of rigid support, as a poroplastic jacket, or a light spinal instrument, will commonly be required, especially for the poorer classes of patients. In ordering such supports, however, the patient should be made to thoroughly understand that no real improvement of the curvature must be expected from them, their only aim being to relieve pain when present, to give a sense of comfort and support, to improve the outward appearance, and to prevent further deformity. In slight cases they should on no account be used. The exercises that I employ are directed in part to improving the muscular tone generally, and in part to strengthening those muscles in particular that tend to lessen or straighten the curves. For the former purpose, such exercises as swinging by the hands from a bar, forcibly stretching an elastic cord fixed to the floor, and dumb-bell exercise, should be practised. For strengthening the muscles in particular that tend to straighten the curve, the back should be manipulated till that posture is found in which the curves are least marked, and the patient made to hold herself in this position for as long as possible. At first she will be only able to do this for a few minutes at a time; but by frequently assuming the posture the muscles thus brought into play are gradually strengthened till at last the improved posture is maintained constantly and without effort. For further improving the tone of these muscles Professor Busch and Mr. Roth recommend some such exercise as the following:—The patient's body held in the improved posture is brought over the end of a couch or table, and whilst she is prevented from falling by an assistant holding her legs, she alternately flexes and extends her body at the hips whilst the Surgeon resists her efforts. I have also found the use of the sloping seat, as recommended by M. Bouvier and Mr. Barwell, of considerable service in counteracting the curves. A similar effect may be obtained by wearing a thick sole on one boot, and by sitting on the off-side of the horse when riding. After the exercises, or twice or thrice during the day, the patient should lie on her back for half an hour to an hour, and whilst sitting her back should be supported by a reclining chair.

KYPHOSIS is a general curving of the spine with its convexity backwards, or an exaggerated condition of the normal dorsal curve. It depends upon an unequal compression of the intervertebral cartilages and to a less extent of the vertebral bodies which thus become wedge-shaped with their bases looking posteriorly. It is generally the result of muscular debility, rickets, slouching habits, or occupations necessitating stooping. The point of chief interest is to distinguish it from the serious angular curvature induced by caries. In children, and in adults, this is usually easy; but in rickety infants, in whom the usual tests for caries (see p. 597) cannot be applied, it is often very difficult. In such a case, the infant should be laid across the nurse's knees and gently extended, when the rickety curve will disappear, but the angular will remain. The back, moreover, in caries, is rigid, and the child is uneasy in this position and tries to resist the extension by

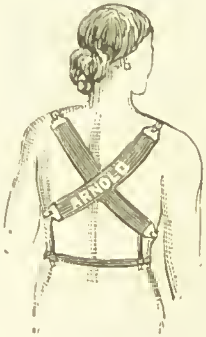


FIG. 216. — Author's spinal brace.

muscular effort, and draws up his legs. In rickets the back is flexible and there are other signs of rickets.

Treatment.—In the infant, recumbency; in growing lads and girls the correction of stooping habits by the use of muscular exercise and a spinal brace (Fig. 216), with partial recumbency, and tonics, is the treatment usually indicated. For the confirmed kyphosis of the old, nothing can be done.

Lordosis, or curving of the spine with the convexity forwards, is a symptom rather than a disease, inasmuch as it is formed as a compensatory curve to restore the equilibrium of the spine when from any cause its normal antero-posterior curves are disturbed. Thus it is most common in the lumbar region, where it is merely an exaggeration of the normal curve; and is there produced to counterbalance the tilting forward of the pelvis consequent upon hip-disease, congenital dislocation of the hip, rickets, &c.

Caries of the spine, also called Pott's disease after the Surgeon who first accurately described it, is characterized by the destruction of one or more bodies of the vertebræ or intervertebral cartilages, and in consequence of this destruction is too frequently attended by the falling forward of the vertebræ above the seat of disease and the production of angular deformity of the spine. Hence it is often spoken of as *angular curvature.* The curvature, however, is only a symptom, and a comparatively late one, of the disease, and ought not to be allowed to form.

Causes.—The disease generally occurs in strumous children, and is then believed, like fungating caries in the articular ends of bone, to be due either to a low form of inflammation set up by a slight injury, or to a deposit of tubercle dependent upon the introduction of the tubercle bacillus into the circulation in the manner already mentioned in the section on *Tubercle.* It sometimes occurs in adults who are otherwise perfectly healthy, and can then generally be traced to some injury of the back—probably a strain of the intervertebral cartilages.

Pathology.—The disease most frequently begins in the bodies of the vertebræ, less frequently in the intervertebral cartilages; but in either case both structures soon become involved. In the bodies it generally starts as a rarefying osteitis in the actively-growing layer of bone which exists under the epiphysial cartilages and periosteum. The inflammatory changes that ensue are similar to those already described in rarefying osteitis of cancellous bone. The red gelatinous inflammatory material or granulation-tissue invades both the body of the vertebra and the intervertebral cartilages, and may then attack the vertebræ above and below. Not infrequently several of the vertebræ are affected independently by the disease at the same time. In this granulation tissue non-vascular areas, presenting the appearance of the tubercle nodules already described, have been found, and tubercle bacilli have in some cases been demonstrated in them. At this stage the disease may cease, the granulation-tissue become converted into bone, and no angular deformity result. More commonly, however, the granulation-tissue having destroyed the bone-trabeculæ, undergoes caseation, and breaks down into pus, producing a *spinal abscess;* or it may be absorbed without the formation of any pus (*dry caries*); or if the process has been very acute, large portions of the cancellous tissue may die *en masse*, forming sequestra, which may keep up the morbid process for years (*caries necrotica*). In any of these cases angular deformity will be the result, as partly by its own weight, and partly by the dragging of the abdominal muscles, the upper portion of the spine thus undermined falls forward, and necessarily forms an angle with the lower portion at the seat of the disease.

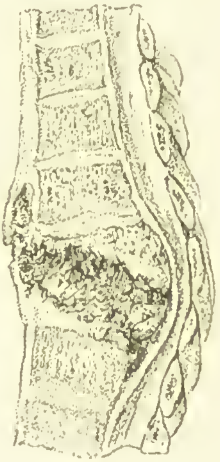


Fig. 217. — Caries of the spine. (St. Bartholomew's Hospital Museum.)

In consequence of the patient's efforts to hold himself upright the normal lumbar and cervical curves, when the disease occurs in the dorsal region, will be greatly increased; the angular projection is thus thrown backwards (Fig. 217), and the well-known hump-back produced. When the disease occurs in the lumbar region there is no means of restoring the balance, and the patient is compelled to stand or walk with the body inclining forwards, and, in severe cases, nearly at a right angle with the pelvis. When the disease begins in the intervertebral fibro-cartilages, it probably starts as a low form of destructive inflammation consequent upon a slight laceration or other injury of the cartilage. But however it begins it soon involves the adjacent bones, destroying them along with the cartilage and leading to the angular deformity. The spinal canal, situated as it is in the posterior segment of the column, with the exception of being bent, undergoes but little alteration of its calibre, and the cord, as the bending of the canal occurs but slowly, consequently usually escapes injury. When the disease is acute and the bending consequently more rapid, some amount of temporary paralysis may occur, impairment or loss of motion being far more frequent than loss of sensation on account of the proximity of the anterior motor columns to the diseased vertebral bodies. The cord is occasionally pressed upon by portions of bone separated from the vertebræ, or by pus making its way into the canal, or by inflammatory thickening of the membranes (*pachymeningitis*). It may sometimes undergo softening, leading to permanent paraplegia.

Spinal abscess (*psoas and lumbar*).—When suppuration occurs, the pus collects in front of the diseased vertebræ in the angle formed by the falling forward of the upper upon the lower portion of the spine. The anterior common ligament and periosteum, relaxed by the bending of the spine, yield to the pressure of the pus, and with the pleura or peritoneum become thickened and form the abscess wall. The pus, prevented from travelling upwards by the overhanging vertebræ, downwards in front of the column by the attachments of the anterior common ligament, and backwards by the posterior common ligament, and by the vertebræ being less diseased behind than in front, makes its way on one or other side of the column. There it either enters the sheath of the psoas, and destroying the contained muscle, presents in the iliac fossa or groin as an iliac or a psoas abscess, or passes backwards through or external to the quadratus lumborum, and points in the loin where it is known as a lumbar abscess. Occasionally the abscess forms on both sides of the spine at once. In the cervical region the abscess will point in the pharynx (*post-pharyngeal abscess*), or in the neck.

Process of cure.—Under favourable circumstances the granulation-tissue undergoes ossification without the production of any deformity; but after the deformity has taken place, and the vertebræ above and below the disease have come into contact by the falling forward of the upper portion of the spine, the destructive process, if the parts are kept at rest, may cease; and firm osseous ankylosis, but with a permanent angular curvature, will ensue.

Symptoms.—In the early stages, before the angular deformity is produced, pain is felt on percussion over the diseased vertebra, or better on the head of the rib in connection with it, or on gently pressing on the shoulders or tapping on the head or on applying hot sponges to the spine. Pain also is felt in the course of the intercostal nerves, and is increased on movement. Hence the spine is held stiffly by the muscles. The movements of the child are characteristic. If asked to pick up anything he does not bend his back, but placing his hand upon his knee to support his spine, reaches the ground by bending his legs and holding his back straight. If asked to turn round he rotates the whole body, not the back. He walks about supporting his spine by resting his hand on the various portions of furniture, and soon gets tired of play, and is noticed to lie about on the floor. In older patients tingling or numbness may be complained of in the extremities, and a feeling as if a cord were stretched tightly round the body. Later, a prominence of one or more vertebræ occurs, and the nature of the disease can no longer be doubted. If neglected, the prominence increases, and the well-known angular deformity is produced. Now, especially if the disease is high up the spine, some loss of motion of the lower extremities occurs, and may proceed to complete paralysis of motion. Sensation is not usually affected, as the posterior columns, being removed from the disease, escape. Nor are the bladder and rectum usually implicated. If an abscess has not already formed, and especially if the disease is moderately low down, one may now present in the loin (*lumbar abscess*), in the iliac fossa (*iliac abscess*), or in the groin (*psoas abscess*). The first gives rise to a fluctuating tumour between the last rib and the crest of the ilium just external to the erector spinæ; the second to a swelling in the iliac fossa. The psoas abscess may be known by the swelling being at first external to the femoral vessels, by the impulse on cough, and by fluctuation being detected on pressing above and below Poupart's ligament. The abscess makes its way under the femoral vessels, and then generally points at the inner and upper part of the thigh, and there breaks. After the opening of these abscesses hectic but too frequently sets in, and the patient succumbs to the long-continued suppuration producing exhaustion or lardaceous disease; or he is carried off by tubercle in the lungs or other organs. Under more favourable circumstances the abscess may heal, firm ankylosis of the spine occur, and the patient recover with a permanent hump-back.

Diagnosis.—In the early stages caries must be diagnosed from neuralgia, rheumatism, lumbago, aneurism, tumours, and hysteria; and in the later stages the angular curvature may have to be diagnosed from the kyphotic curvature of rickets. From *neuralgia*, *rheumatism*, and *lumbago* it is not always easy to distinguish it. The history of a former rheumatic attack, the effect of remedies, and the absence of the signs given above, must then be relied upon. *Hysteria* may simulate it very closely. The absence of signs of caries, except pain; the inconstant and more diffused character of the pain; and the presence of other signs of hysteria or of uterine disease, are the points to be attended to. A careful auscultation of the chest, and examination of the abdomen, will usually serve to exclude *aneurism*. From *tumours* of the vertebral bodies leading to the breaking down of the vertebræ caries cannot at first be diagnosed, as both give rise to the same symptoms. The curve of *rickets* is more generally kyphotic, and disappears more or less completely on gently holding the child up by its arms, or extending it with its face downwards across the nurse's knees. There are, moreover, concomitant signs of rickets, and absence of those of struma.

Treatment—Both constitutional and local measures are required. The former are those already described under *Struma* and *Tubercle* (p 47). The chief local indications are to keep the spine at rest in order that the diseased vertebræ may be placed in the most favourable condition for repair. This may be attempted in two ways—1, by absolute recumbency; and 2, by the use of some form of spinal support. 1. *Absolute recumbency* from six to twelve months in the supine or prone position on a properly constructed couch is the best method of treatment where the patient can be properly cared for, has airy apartments, can be taken out in this position in an invalid carriage, and can reside in the country or at the seaside. Especially is this treatment the best when the disease is situated high up in the spine, *i.e.*, in the upper dorsal or cervical region, and it is imperatively necessary where there is paralysis. To ensure absolute recumbency I have lately largely employed a double Thomas's splint (Fig. 218), modified by the addition of a pelvic band, a support for the shoulders neck and head, and two sliding foot-pieces. The two upright bars, which are prolonged to the head support, are made after the shape of a normally formed child when in the recumbent position, and give support to both sides of the spine. Two cross-bars support the body, just below the axillæ and pelvis respectively; the legs are kept in position by the ordinary circlets and foot-pieces. The splint is placed next the skin so as not to require removal while the child is washed, dressed, &c. It not only fixes the spine and takes off the weight of the head and upper limbs, but also fixes the lower limbs and thus prevents the psoas muscles from dragging on the spine. Absolute recumbency, when properly carried out, offers the best prospect of averting serious angular deformity and paralysis; as soon, however, as the acute symptoms quiet down some form of spinal support should be applied, and the patient cautiously allowed to take a certain amount of exercise. But amongst the poor, where the children are often left to themselves during the greater part of the day, absolute recumbency can seldom be ensured; and if it could, its advantage over other methods would be counterbalanced by the severe detriment to the health which the child would suffer in consequence of confinement to an ill-ventilated room, &c. For such patients some form of support, not only to restrain as much as possible the motions of the spine, but also to allow them to obtain a certain amount of fresh air, is generally necessary. 2. The *supports* most in use at the present day are Sayre's plaster-of-Paris case and Cocking's poroplastic felt jacket, though some Surgeons still prefer steel instruments. The plaster-of-Paris case may be applied with the patient either

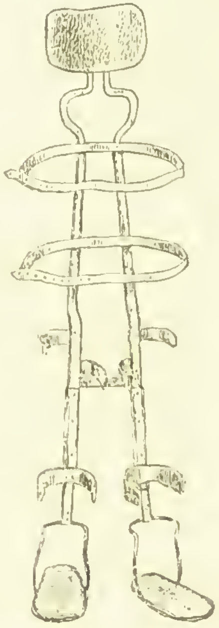


FIG. 218.—Double Thomas's splint for spinal caries.

in the upright position, suspended, with his heels just off the ground, by Sayre's tripod, or in the recumbent position by Davy's hammock apparatus. A skin-fitting vest having been previously applied, and a line drawn across the back with a pencil at the level of the axillæ to indicate the upper limit of the jacket, crinoline bandages, impregnated with plaster-of-Paris, are wound round and round the trunk till a sufficient thickness is obtained, dry plaster being from time to time rubbed in with the hands. The case should reach from the pencil line to just below the crest of the ilium, stopping short of the great trochanter and the pubes, and may be strengthened, if necessary, in places by inserting strips of perforated tin vertically between the bandages. Before applying the bandages, a folded silk handkerchief should be placed over the abdomen beneath the vest, so that when afterwards withdrawn space will be left for abdominal respiration (*Sayre's stomach-pad*). When the plaster case is dry it may be sawn through down the front, removed, the fronts edged with leather, and perforated with eyelet-holes, so that it can be worn laced up, and be taken off from time to time. To apply the poroplastic felt, the jacket, which is first made to measure, must be put in a steam oven, and when rendered thoroughly plastic, further moulded to the patient, who should be prepared and suspended in the same way as for applying plaster-of-Paris. Of steel instruments, that known as Taylor's is perhaps the best. In my own practice, however, I almost invariably employ the poroplastic jacket. Where the disease is in the cervical or upper dorsal region, Sayre's jury-mast may be fitted to the plaster-of-Paris case or poroplastic jacket; or a cervical collar composed of leather or poroplastic felt may be used, or better, the combined poroplastic jacket and collar devised by the author. Should an abscess form, it should be treated in the way described under Chronic Abscess. In some cases where necrosis has been associated with caries, success has attended the removal of the sequestrum through a properly-planned incision made in the loin.

OCCIPITO-ATLOID, and ATLO-AXOID DISEASE, are terms applied to tuberculous or strumous inflammation attacking the articulations between the occipital bone and the atlas, and the atlas and the axis respectively. Hence the disease resembles in its course tuberculous disease of the joints, rather than tuberculous disease of the bodies of the vertebræ. It may begin either in the synovial membranes, or as caries of the bones forming the articular processes, and when occurring between the atlas and the axis usually affects the synovial membranes between the odontoid process and the transverse ligament on the one hand, and the tubercle of the atlas on the other. Indeed in this situation it would often appear to begin as a caries of the odontoid process itself, and then spread to the synovial membranes. The disease is often attributed to a sprain of the neck, but though it may sometimes be excited by such, would appear more probably to depend on causes similar to those leading to tuberculous or strumous disease elsewhere.

Symptoms.—Pain is first felt over the seat of the disease, and radiating in the course of the nerves emerging from the intervertebral foramina between the affected bones. It is increased on attempting to turn or nod the head, but is relieved by supporting the chin with the hand. Hence the patient often holds his head between his hands, and if asked to rotate it, turns his whole body, keeping his neck stiff and immovable the while. When the disease is chiefly limited to the articulations between the occipital bone and the atlas, the pain is principally confined to the region supplied by the suboccipital nerve, and is increased on nodding rather than on rotating the head. As the disease advances, the atlas, with the occipital bone, has a tendency to slip forward on the axis—directly forward if both sides are equally diseased, or more to one side if the disease is unilateral. The spine of the axis in consequence appears more prominent than natural, and the head on a plane anterior to that of the rest of the spinal column. Should an abscess form it may point at the back of the pharynx (*post-pharyngeal*) or at the side of the neck. *Treatment.*—Absolute rest on the back, with the head between sand-bags, is imperative, as there is danger of fatal compression of the cord from the odontoid process or the transverse ligament giving way during some sudden movement of the patient. In some cases attended with paralysis below the disease, continuous extension and counter-extension, with the patient in the recumbent position, has been successful in removing the pressure from the cord. When the acute symptoms have subsided, a moulded collar of leather or poroplastic felt, or an inflating india-rubber collar, will be required.

SPINA BIFIDA "is a congenital malformation of the vertebral canal with protrusion of some of its contents in the form of a fluid tumour." It is nearly always met with in the middle line of the back, but very exceptionally the protrusion has occurred through the bodies of the vertebræ instead of posteriorly through the cleft spines. It is due to an arrest of development of the laminæ of the vertebræ (*mesoblastic elements*), and their consequent failure to unite in the middle line to form the spinous processes. This non-union may possibly be sometimes owing to an excess of cerebro-spinal fluid. A spina bifida may occur in any part of the spine, but is most common in the lumbo-sacral region, where the laminæ are the latest to unite. It may be associated with other deformities, especially club-foot.

Pathology.—Three chief forms of spina bifida are described:—1, spinal meningocele, 2, meningo-myelocele, 3, syringo-myelocele. 1. In *spinal meningocele* the sac (Fig. 219) consists of dura mater and arachnoid blended together, and consequently communicates with the subarachnoid space and contains cerebro-spinal fluid. The cord and nerves remain in the spinal canal. Very rarely the sac is said to consist of dura mater only; it would then communicate with the subdural space and contain arach-

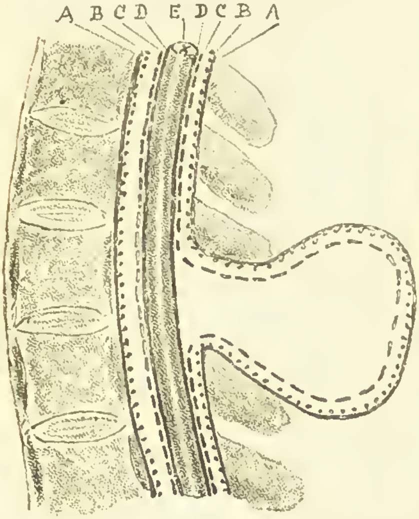


FIG. 219.—Spinal meningocele.

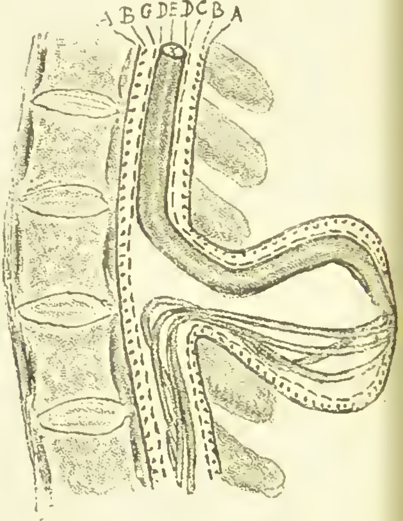


FIG. 220.—Meningo-myelocele.

In the three diagrams the letters have the same reference. A. Dura Mater. B. Parietal, and C. visceral arachnoid. D. Pia Mater. E. Cord.

noid fluid. 2. In the *meningo-myelocele* (Fig. 220), the most common form, the sac also consists of dura mater and arachnoid, and contains in addition to cerebro-spinal fluid, the spinal cord and nerves, which are often spread out over and intimately blended with the posterior part of the wall of the sac. As the cord passes through the sac some of the large nerve-cords given off from it run forwards across the interior of the sac to re-enter the spinal canal. Hence those nerves that are given off from the cord where it is adherent to the sac-wall, appear to arise from the sac, and were formerly described as being distributed to it (see Fig. 220). 3. In the *syringo-myelocele* (Fig. 221), the most rare form, the central canal of the cord is greatly distended with fluid, and the expanded cord is thus spread out over the sac-wall, with which it is intimately blended. The nerves in this case pass through the walls of the sac to their destination. *The coverings of the sac* may be healthy skin; but more commonly normal skin is only found at the sides, the central portion consisting of a thin bluish membrane. Sometimes a slight depression is seen on the lower part of the sac at the spot where the cord terminates in the wall. This is called the *umbilicus*, and at its bottom the central canal of the cord has at times been seen to open.

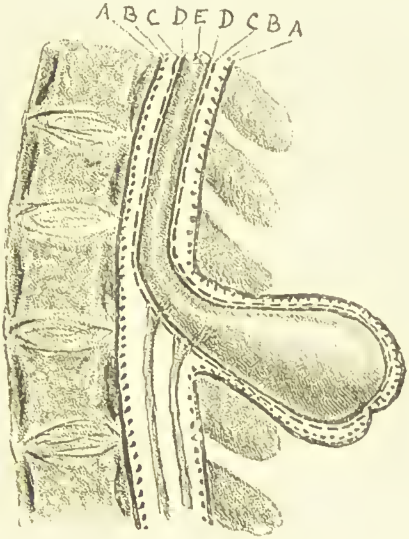


Fig. 221.—Syringo-myelocele.

In rare instances there has been no protrusion, but rather a depression in the situation of the cleft between the vertebræ (*spina bifida occulta*), the cleft being occupied by the blended membranes, cord, and skin, and the spot covered with a tuft of hair.

Symptoms.—The swelling is usually of a globular or oval shape, translucent, sessile or slightly pedunculated and flaccid, but becomes tense and distended on coughing or straining. Pressing upon it sometimes causes the fontanelles to swell up, and may produce convulsions. When the spinal cord and large nerves are involved, there may be paralysis of the extremities or of the bladder or rectum. The gap between the laminæ of the vertebræ may at times be felt on pressing on the sac. As a rule these tumours show a great tendency to enlarge, and rupture spontaneously, in which case death usually follows from the draining away of the cerebro-spinal fluid, and septic meningitis. Death, however, is sometimes due to marasmus and defective nutrition. When a spontaneous cure takes place it is usually due to the gradual shrinking of the sac.

Diagnosis.—Its congenital origin will at once distinguish a spina bifida from a new growth developed subsequently to birth; and its situation in the middle line, translucency, increase of tension on straining, and the gap between the laminæ when this can be felt, will usually serve to diagnose it from other congenital tumours.

Treatment.—As there are no means of accurately determining that the spinal cord is not in the sac, it is not safe to attempt excision or ligature, although these operations have at times been attended with success. Repeated tappings are very fatal. The best treatment, except when the spina bifida is very small or is apparently undergoing a spontaneous cure, is to inject the sac with Dr. Morton's iodo-glycerine fluid, as this method when successful causes the tumour to shrink, and most closely follows the process of nature when a spontaneous cure occurs. The injection is best performed when the child is two months old; but it may be done earlier when the sac threatens to burst. "The best results may be expected when there is no hydrocephalus or paralysis, and the sac is covered by healthy skin." It is contraindicated when there is "advanced marasmus, great and increasing hydrocephalus, and intercurrent disease." The child should be placed on its side, and the puncture made obliquely through healthy skin on one side of the base of the tumour, and not through the thin and imperfectly formed skin which nearly always covers the sac in the middle line, "the object being to avoid wounding the expanded spinal cord, and the subsequent leakage of the cerebro-spinal fluid." About a drachm of the iodo-glycerine fluid (iodine, grs. x.; iodide of potassium, grs. xxx.; glycerine, ℥i.) should be injected, and the injection repeated in a fortnight if the first trial is not successful. The fluid contained in the sac should not be drawn off before the injection. The advantage of Morton's fluid over tincture of iodine alone is that owing to the glycerine it contains it uniformly diffuses itself over the sac walls. The injection of iodo-glycerine is not unattended with danger; therefore when the sac is small and its walls are thick, and it is not increasing in size, beyond protecting it with a metal or leather shield, no further treatment should be attempted.

SURGICAL DISEASES OF THE INTESTINES.

INTESTINAL OBSTRUCTION.

The pathological conditions that may give rise to intestinal obstruction are very various, and may be considered under the following heads:—

1. IMPACTION OF FÆCES OR FOREIGN BODIES IN THE INTESTINES.—Accumulation in the rectum and colon of hardened fæces, the result of habitual or accidental constipation, is not uncommon; and the impaction of gall-stones or intestinal concretions in the small intestines, though more rare, is also met with. Obstruction from these causes is more common in women than in men.

2. INTERNAL STRANGULATION OF INTERNAL HERNIA.—These terms are applied to obstruction of the intestine by some constricting agent within the abdomen. The strangulation may be effected by: 1. Bands produced by the stretching of old inflammatory adhesions, the result of former peritonitis. These are more particularly common about the mouths of old hernial sacs. 2. The remains of some fœtal structure, as the omphalo-mesenteric duct, Meckel's diverticulum, &c. 3. A coil of intestine slipping through a hole in the mesentery or omentum.

3. VOLVULUS is a twisting or bending of a coil of intestine, so that its calibre is completely obliterated at the bent or twisted spot. Accumulation of flatus, constipation

and unequal distension have been assigned as causes. Volvulus is said to be most common in the sigmoid flexure; and always to be situated towards the back of the abdominal cavity. The intestine may be—1, simply bent upon itself; 2, twisted round its mesentery; and 3, wound round another coil of intestine. The first form only occurs in the colon; the second in the small intestine; the third form usually consists of the colon wound round a coil of small intestine, the sigmoid flexure, or the cæcum.

4. INTUSSUSCEPTION (Fig. 222) is the invagination of a portion of intestine into the lumen of the intestine immediately below. The intestine thus forms three tubes, one within the other, an outer, middle, and inner (Fig. 223). The external tube is called the sheath, the innermost the entering tube, the middle the receding or inverted tube, the last two together being further called the intussuscepted portion. Thus there are two peritoneal and two mucous surfaces of the intestine in contact (Fig. 223), and between the inner and middle tubes is a portion of the mesentery or meso-colon, which is necessarily drawn down with the intestine. The dragging of the mesentery causes the intussuscepted portion to assume a greater curve than its sheath, and hence to become puckered along its con-

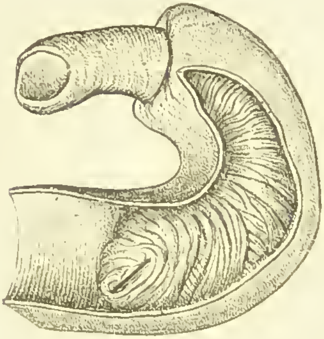


FIG. 222.—Intussusception. (St. Bartholomew's Hospital Museum).

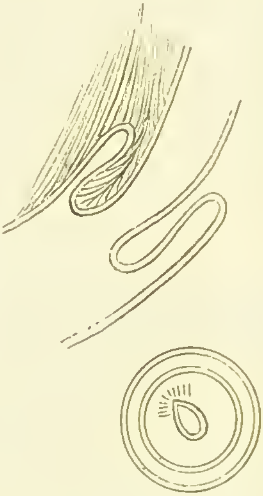


FIG. 223.—Diagram of intussusception.

cavity; it also causes the orifice of the intussuscepted portion to be directed towards the mesenteric attachment and to be slit-like in shape. The intussusception nearly always increases at the expense of the lower portion of the intestine, the sheath becoming more and more infolded, so that, if the intussusception occurs at the lower part of the ileum, no more of the ileum will be involved, but the cæcum and colon may be gradually drawn in. Very rarely, however, the ileum is protruded through the ileo-cæcal valve; the intussusception then increases at the expense of the upper portion of the intestine, more and more of the ileum being protruded through the valve. This variety is known as the *ileo-colic* in contradistinction to the former, which is called the *ileo-cæcal.* At first the invagination is reducible, and is not attended with any serious obstruction to the lumen of the intestine. In this condition it may remain, in chronic cases, for several weeks or months. Or the mucous membrane of the intussuscepted portion may become congested and swollen, rendering reduction difficult or impossible without rupture or other injury of the intestine. In the majority of cases, however, especially in infants, if the intussusception is not soon relieved, the blood-vessels of the involuted mesentery rapidly become constricted where the latter enters the sheath, causing acute obstruction to the circulation in the receding tube. As a consequence of this, the mucous membrane becomes intensely congested, and pours out the sanious discharge so diagnostic of the disease. In the meanwhile the contiguous peritoneal surfaces of the inner and middle tube become inflamed and glued together, rendering reduction impossible. Gangrene of the intussuscepted portion now ensues, and the patient dies of collapse or peritonitis in a few days. In adults, however, and in children of six or eight years and upwards, the gangrenous portion may slough off at the constricted part and be passed per anum, but in children under two years of age the disease, unless relieved by treatment, is almost invariably fatal. Should recovery take place in this manner, the patient may subsequently succumb to stricture of the intestine, from contraction occurring at the spot where the intestine has united. The intussusception may measure only two or three inches in length, or it may involve the whole of the large intestine and protrude at the anus. It is attributed to worms, the dragging of a polypus, irregular peristalsis, diarrhœa, and external violence. Its most common situation is at the ileo-cæcal valve, then in the small intestine, then in the colon. It is rare in adults, but common in children, especially in infants.

5. STRICTURE OF THE INTESTINE CONSEQUENT UPON DISEASE OF THE INTESTINAL WALL.—This condition is generally due to the growth of a carcinoma or other tumour, more rarely to contractions following ulceration or injury, or operation on the intestine. It is most frequently met with in the large intestine, especially the rectum and lower part of the colon, and is rare in the small intestine.

6. CONTRACTIONS OF THE INTESTINE CONSEQUENT UPON DISEASE COMMENCING EXTERNAL TO THE INTESTINAL WALL.—This condition may depend on chronic peritonitis, or on carcinoma of the omentum or mesentery. It is more common in the small than in the large intestine, and not only narrows the calibre of the bowel, but also obstructs the peristaltic action by gluing the coils of intestine to one another and causing contraction of the mesentery.

7. ACUTE PERITONITIS AND ENTERITIS are not uncommon causes of intestinal obstruction. Peritonitis, moreover, is a frequent termination of the other conditions that cause obstruction, but is perhaps most often due to inflammation spreading from the region of the cæcum (*peri-typhlitis*), or the bursting of a peri-typhlitic abscess into the peritoneal cavity. This inflammation about the cæcum is not infrequently started by the impaction of a foreign body, as a fruit or gall-stone or little mass of hardened fæces, in the vermiform appendix. In such cases, moreover, ulceration or gangrene of the appendix may take place, setting up localized or diffuse peritonitis. Enteritis is most common in the cæcum (*typhlitis*).

8. CONGENITAL MALFORMATION OF THE INTESTINE.—Amongst the chief of these may be mentioned imperforate anus, deficiency of the rectum, absence of the colon, termination of the colon in the bladder, &c. Obstructions from such and like causes are only met with in the infant (*see* Diseases of Rectum, p. 657).

9. EXTERNAL HERNIA.—All forms of external herniæ when strangulated, and generally when incarcerated or inflamed, are productive of obstruction of the intestine (*see* Hernia, p. 625).

Terminations of intestinal obstruction.—Whatever the cause of the obstruction, the intestines become sooner or later enormously distended with fæcal matter and flatus, and if the obstruction be not removed the case will terminate fatally from exhaustion, peritonitis, or rupture of the intestine followed by collapse and peritonitis.

The SYMPTOMS of intestinal obstruction vary according to the pathological conditions upon which the obstruction depends. The symptoms common to all may be said generally to be pain, vomiting, constipation, and more or less distension of the abdomen. When the *obstruction occurs suddenly*, and is attended by *strangulation* of a portion of intestine, as in 1, the various forms of constriction produced by bands; 2, a portion of intestine slipping through a hole in the mesentery or omentum; 3, volvulus, and 4, external strangulated hernia, the symptoms are also *sudden* in their onset and *acute* in their course, as is likewise generally the case when they depend upon intussusception, the impaction of a gall-stone or other foreign body, the sudden accumulation of fæces above a stricture, or acute enteritis or peritonitis. Thus the pain is severe and violent, and occurs suddenly in a person in previously good health; the vomiting comes on early, and may rapidly become fæcal; the constipation is complete from the first; flatus will not pass by the anus; the urine may be scanty or suppressed; there is frequently hiccough and tympanites; and the patient soon falls into a state of extreme collapse and dies. When, on the other hand, the *obstruction comes on more slowly*, and a portion of intestine is *obstructed* rather than *strangulated*, as from (1) progressive stricture of the rectum or colon; (2) the pressure of abdominal or pelvic tumours; (3) the gluing of the intestines together by chronic peritonitis or cancer; (4) the gradual accumulation of fæces, due to habitual constipation, and (5) chronic intussusception, the symptoms are also *insidious* in their onset and *chronic* in their course. Thus, obscure abdominal symptoms may have existed for some time. The pain is less severe, more diffused, and may be intermittent, but increases with the distension. Vomiting only occurs late in the course of the affection, and does not become fæcal till towards the last. Constipation is not complete at first, the motions may be scybalous, and there may be a history of alternating constipation and diarrhœa. The distension of the abdomen is gradual and is, perhaps, more marked in the lumbar and epigastric regions. The abdomen appears broad, and coils of intestine may be visible owing to increased peristalsis consequent upon hypertrophy of their muscular coat. The urine is normal. A stricture may perhaps be felt in the rectum by the finger, or in the sigmoid flexure by passing the hand. Collapse does not come on till the end. Such, broadly, may be said to be the symptoms attending acute and chronic intestinal obstruction. But it must not be forgotten that the conditions which commonly give rise to chronic symptoms may, at any time, suddenly terminate in complete obstruction and strangulation, when the symptoms will at once become acute. Thus a slowly contracting stricture may become suddenly obstructed by the impaction of fæces, or by a portion of intestine immediately above becoming invaginated into it; or acute peritonitis may suddenly supervene, owing to the giving way of an ulcerated portion of intestine above a stricture, &c.

The DIAGNOSIS of the various pathological conditions causing obstruction or strangulation of the intestines, though sometimes comparatively easy, is often very difficult, or even impossible. Your first care, when called to a patient with signs of acute abdominal obstruction, *i.e.*, pain, vomiting, constipation, and possibly distension of the abdomen, should be to exclude external strangulated hernia, not merely contenting yourself with examining the femoral and inguinal rings, but also making a careful search in the less common situations of hernia, as the obturator foramen and sciatic notch. Should there be any fulness, or the least suspicion of strangulation in any of these regions, an exploratory incision should be made. Having satisfied yourself of the absence of external hernia, you should next carefully examine the abdomen by inspection, palpation, and percussion, and explore the rectum and vagina with the finger; whilst the former canal may, in some instances, be further examined by carefully passing a long enema-tube or even by introducing the whole hand. Should a hernia be discovered exhibiting well-marked local signs of strangulation, or on introducing the finger into the rectum a stricture be felt or the bowel be found loaded with hardened fæces, or blood and slime escape from the anus and a sausage-shaped tumour be detected in the abdomen or rectum, the diagnosis of strangulated hernia, stricture of the rectum, impaction of hardened fæces and intussusception respectively can be readily made. But when, on the other hand, the hernial rings are found free, the rectum empty, and nothing can be felt in the abdomen, the difficulty of localizing the cause of the obstruction is great, and even after the most careful examination and thoughtful consideration of the symptoms it may only be possible to arrive at an approximate guess as to the nature of the case. Thus, if the symptoms are acute, the obstruction will probably be due to some form of internal strangulation or to a volvulus; but it must not be lost sight of that it may be due to peri-typhlitis, acute enteritis or peritonitis, or possibly to the impaction of a gall-stone. If the symptoms are chronic it may be due to stricture in the upper part of the rectum or lower part of the colon, malignant disease of the omentum or intestine, or chronic peritonitis. If acute symptoms have been engrafted on chronic, it may then be caused by the impaction of fæces above a stricture, peritonitis following perforation above a stricture or impaction of a foreign body in the vermiform appendix, typhlitis, or peri-typhlitis. Although it may be impossible to make a diagnosis, the following considerations may help us. Thus, if the onset of the symptoms is sudden and the patient is an infant or a young child, the cause of the obstruction will probably be intussusception or peritonitis. If the patient is elderly or middle-aged, and the symptoms are chronic, malignant stricture or impaction of fæces is the most probable cause. In middle age intussusception is rare. The tendency to vomit is in proportion to the nearness of the obstruction to the stomach, the tightness of the constriction, and the persistence with which food or fluid has been taken by the mouth. Early vomiting implies tightness of the stricture; violent retching or bile-vomiting points to gall-stones; fæcal vomiting only occurs when the obstruction is moderately low down. Vomiting may be absent in the case of obstruction of the colon or rectum. Finally, if peristalsis is visible, the case is almost certainly not one of acute peritonitis.

1. In *impacted fæces* there may be a history of previous constipation, the rectum will probably be found distended, or motions will be passed on the use of enemata. A swelling may be felt through the abdominal parietes, and f so will be soft, and can perhaps be indented with the ingers. In *obstruction from gall-stones*, there may be pain in the region of the gall-bladder, perhaps jaundice; gall-stones may have passed, or similar attacks have been

previously suffered from, and the bowels may have acted irregularly. The vomiting is gastric or bilious, and is attended with violent retching,

2. In *internal strangulation* the attack is very sudden, and is probably attributed to a strain; the pain is intense, and is referred to one spot, or to the umbilicus; vomiting comes on early; the constipation is sudden; there is no desire to defæcate; the urine is scanty; there is no visible peristalsis; no tumour can be felt; there is no hæmorrhage from the bowel; and no tenesmus. There is probably a history of some disease which might produce bands of adhesions, as peritonitis or typhoid fever; or there may have been previous attacks of abdominal obstruction with intervals of perfect health.

3. In *volvulus*, the signs are similar to the foregoing, but if anything still more severe.

4. In *intussusception*, when *acute*, there is a discharge of mucus and blood from the anus; the abdomen is not much distended; the abdominal parietes are usually lax, and through them a sausage-shaped tumour, doughy to the feel, hardening on handling, and perhaps changing its position from day to day may be detected; and the invaginated bowel can possibly be felt in the rectum. Collapse soon occurs. When *chronic*, there may have been attacks of localized pain lasting for months before strangulation occurs, the patient having been in good health in the intervals. There is straining and tenesmus; the constipation is not complete; vomiting is absent or intermittent; the distension is not marked; and collapse does not come on till the end. The tumour will have characters similar to those mentioned above.

5. In *stricture* the patient is usually old or middle aged; the symptoms come on very insidiously; there are alternating attacks of constipation and diarhœa; the constipation gradually becomes more and more pronounced; the motions are probably lumpy (*scybalous*), pipe-like, or flattened; dyspepsia is complained of; the pain is diffused and depends upon the distension of the abdomen; the distension comes on slowly, and is greatest in the flanks; peristalsis is visible; the urine is copious; the pulse quiet; and vomiting only occurs late in the case. Having diagnosed the case as one of stricture, the next point to determine is whether it is situated in the sigmoid flexure or rectum, and consequently that opening the descending colon in the left loin or the sigmoid flexure in

the left groin will be well above the stricture; or whether it is situated in the descending or transverse colon, so as to necessitate the opening of the ascending colon. To begin with, it should be remembered that stricture is most common in the sigmoid flexure and rectum, next in the colon, then in the cæcum, and is very rare in the small intestine; indeed, it is so rare, in the two latter situations, that when its exact position is not known, it is generally safe to assume that right colotomy will suffice. Again, if the stricture is in the rectum or sigmoid flexure, the distension will be equal on the two sides; when in the descending or transverse colon, greater on the right than on the left side. The amount of distension on the two sides may be more accurately estimated by the cyrtometer than by mere inspection and palpation. If a clyster-pipe will pass for some distance, say a foot or so, and a large quantity of fluid can be injected, the stricture is probably high up; but too much importance must not be attached to this sign, as the clyster-pipe may have bent upon itself and the rectum and sigmoid flexure are often very capacious. Further, something may at times be learnt by ausculting the colon whilst the injection is being given, and by passing the whole hand into the rectum.

6. In *contractions* there is pain of a paroxysmal nature of short duration and of frequent occurrence; peristalsis may not be visible on account of the matting together of the intestines, but gurglings may be heard. There is no vomiting or distension except during the attacks of pain. Constipation is not complete; defæcation is painless; the motions are not compressed or pipe-like as in stricture; and there is no distension in the flanks. The symptoms may at any time suddenly become acute.

7. In *acute peritonitis* the abdomen is distended from the first, hard, and board-like; peristalsis is not visible; the pain is great and increased on the least pressure; the pulse is small and wiry; the temperature may or may not be raised. (See Peritonitis, p. 391). There will probably be a history of previous attacks of typhlitis or peri-typhlitis.

For the signs of enteritis, typhlitis, and peri-typhlitis, see a work on Medicine.

TREATMENT.—Supposing any of the above conditions to have been diagnosed with tolerable certainty, the indications for treatment will be rendered fairly intelligible. Where no diagnosis, however, can be made, the treatment must at first be expectant. Thus in *acute cases*, nothing should be given by the mouth save small pieces of ice to suck, and the patient should be placed under the influence of morphia injected subcutaneously. An enema may be given, but purgatives must of course be avoided. If relief is not soon obtained, laparotomy must be performed, and the abdomen explored; or if the patient's condition is such as not to allow of this, the abdomen may be opened, and the first piece of distended intestine that presents, secured to the edges of the wound, and opened (*Enterotomy*). In *chronic cases*, the diet should be restricted, only small quantities of the most digestible food being given at a time, and as soon as an accurate diagnosis can be made, measures should of course be taken for relieving, if practicable, the obstruction.

1. In *impacted fæces*, when medical means and enemata have failed, the rectum may require clearing with a scoop or other suitable instrument. In *obstruction* from impacted *gall-stones* or other foreign bodies, after the usual remedies have been unsuccessful, the abdomen may be opened, and the gall-stone or foreign body removed through an incision in the intestine, or else made to pass by gentle manipulation through the ileo-cæcal valve. The incision should be made in the longitudinal axis of the gut and be afterwards united by Lembert's suture. Or should the walls of the gut be softened by ulceration, a portion of the intestine may be resected or an artificial anus established by sewing the gut to the abdominal wound.

2. In *internal strangulation*, laparotomy is the only procedure of any avail, and ought, like herniotomy, to be undertaken early and not merely as a last resource (see *Laparotomy*).

3. In *volvulus* of the sigmoid flexure, opium or morphia and an enema should be given; or if there is great distension, the inflated coil, according to Treves, should be punctured through the abdominal parietes. By these means the intestine has in some cases become untwisted. Opening the abdomen, except for volvulus of the intestine other than the sigmoid flexure, is said not to do any good, owing to the tendency of the coil to become re-twisted.

4. In *intussusception*, when *acute*, copious injections of warm water or inflations of air, inversion of the patient, and massage of the abdomen, should be thoroughly tried under chloroform, all care being taken not to rupture the

intestines. In the meantime, opium should be given in doses suitable to the age of the patient, and food withheld. These means failing, laparotomy must be performed If the signs of strangulation are well marked, too much time should not be lost in trying injections, &c., lest the bowel become so damaged as to render the prospect of success hopeless. In *chronic* cases, although there is less need for early operative interference than in acute as the bowel may remain incarcerated for some time before becoming strangulated, it should not be delayed too long, lest the intussuscepted portion become adherent to the sheath. Should it appear probable that this has already happened, two courses are open: either to explore the abdomen and perform enterectomy; or to keep the patient under the influence of opium in the hope that the intussuscepted portion may slough off and be passed *per anum*. In infants intussusception, unless relieved by injections, inflations, &c., or by operative means, may be said to be invariably fatal.

5. For *stricture of the large intestine*, left lumbar or inguinal colotomy should be performed when the obstruction is in the rectum or lower part of the sigmoid flexure, and right colotomy when in the transverse or descending colon. Should the strictured portion be come upon in performing the operation, it may, if the disease is localized, be cut out (*colectomy*) and the bowel secured to the wound, or the two portions of bowel united by suture. In *stricture of the small intestine*, enterotomy may be performed as a palliative, or under suitable conditions, enterectomy, but only where signs of obstruction are present, and where palliative treatment by medical means has been previously employed.

6. In *contractions*, where the intestines are matted together by chronic peritonitis or cancer, when medical means have failed, enterotomy may prove of temporary benefit by relieving the distension.

7. The treatment of *acute peritonitis* is given at page 392. For an account of the treatment of *typhlitis* and *perityphlitis* a work on Medicine must be consulted. Should, however, the inflammation terminate in suppuration and an abscess form, it should be opened and drained, or should such an abscess burst into the general peritoneal cavity, the peritoneum should be washed out. The appendix, if found inflamed, plugged with a foreign body, ulcerated or gangrenous, should be amputated, and

the stump sutured by Lembert's method. When it appears that recurring attacks of typhlitis are due to mischief in the appendix, the question of removing the appendix after the acute attack has subsided may be raised.

LAPAROTOMY, or opening the abdomen, is an operation that may be required for the purpose of exploring in doubtful cases of intestinal obstruction, or for the relief of volvulus, strangulation of the intestines by bands or diverticula, intussusception, reduction of hernia *en masse*, &c. Make an incision in the middle line of the abdomen, midway between the pubes and umbilicus (Fig. 224 A), and

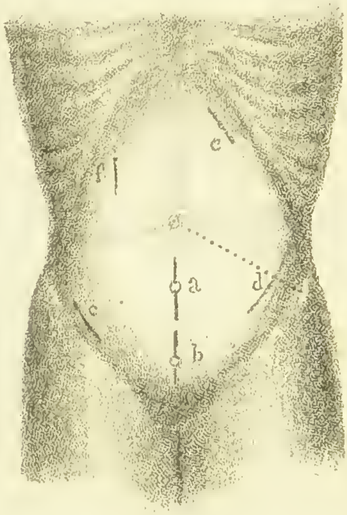


FIG. 224.—Lines of incision in certain operations on the abdomen. A. Laparotomy, Ovariotomy. B. Supra-pubic cystotomy. C. Ligature of external iliac artery. D. Inguinal colotomy. E. Gastrostomy. F. Cholecystotomy.

having exposed the peritoneum and stopped all hæmorrhage, carefully open the peritoneal cavity on a director. Some Surgeons advise that the incision should be limited and only long enough to at first admit one or two fingers; others that it should be sufficiently long to at once allow the passage of the whole hand. Pass one or two fingers or the whole hand into the abdominal cavity and first explore the hernial rings from within, and if these are free the region of the cæcum, taking care to prevent the intestines from protuding by placing over them a warm flat sponge. If the cæcum is found distended, the obstruction must be in the large intestine. Carry your fingers or hand, therefore, along the course of the colon until the obstruction is met with. If, on the other hand, the cæcum is empty, the obstruction must be in the small intestine. Pass your fingers or hand in this case into the pelvis, and search for an empty loop of intestine below the obstruction and follow the intestine till the obstruction is discovered.

(*a*) If a loop of intestine is found strangulated in one of the hernial rings, or in a hole in the mesentery, it must be released from within the abdomen, dividing any stricture if necessary. (*b*) If a volvulus is discovered an attempt must be made to untwist it. (*c*) If a band is met with it must be divided. (*d*) If a large diverticulum is the cause of the obstruction it must be cut across and the bowel end united by Lembert's suture. (*e*) If a small diverticulum is producing the constriction it must be severed and the two ends ligatured. Should the intestine give way in dividing the obstructing band, &c., or have already given way—if the perforation is small and the coats are in a fairly healthy condition, the wound in the intestine may be closed by suturing the edges of it together in the way described under wounds of the intestine. Where, however, the coats are in an inflamed or sloughy condition, an artificial anus may be made by bringing the damaged part of the intestine out of the wound and securing it to the abdominal parietes; or the diseased portion may be cut away together with a wedge-shaped piece of mesentery, and the upper and lower portions of intestine sutured, either to the edges of the wound in the parietes, or better to each other, in the way described under enterectomy. The choice of operation will here depend in great part on the patient's general condition, as it is only in exceptional cases where the powers of the patient are well maintained, that he would be able to stand the shock of the prolonged operation necessarily required to unite the two portions. (*f*) If an intussusception is discovered an endeavour must be made to reduce it; not by trying to draw the intussuscepted portion out of the sheath, which would endanger the integrity of the coats, but rather by kneading it and pressing it out from below. If the inflammatory changes already described under intussusception have advanced to such a stage as to render an attempt at reduction of the intussusception unadvisable or impossible, three courses are open: to leave it to nature, in the hope that the intussuscepted portion may slough away and be passed *per anum;* to secure the intestine above the intussusception to the abdominal parietes, and thus form an artificial anus; or to cut out the intussuscepted portion and unite the upper and lower portions of the intestine to the abdominal parietes, or to each other, as in enterectomy. The right course to pursue will depend upon the general condition of the patient, the state of the bowel at the seat of intussusception, its amount of distension above, and the length of the intussusception. Usually it will be best to cut away the intussuscepted portion and unite the portions of intestine above and below to the wound in the abdominal parietes. But space will not permit of an adequate discussion of this difficult question. After any of the above operations the abdomen should be carefully cleansed by irrigation with warm and weak antiseptics, any excess of fluid pressed out, and the wound closed in the way described under Ovariotomy. (*g*) If the obstruction is found to depend on a perityphlitic abscess or acute peritonitis a drainage tube should be placed in the wound in the abdominal parietes, after the abscess or peritoneal cavity has been washed out.

ENTEROTOMY, or NÉLATON'S OPERATION, consists in opening the abdomen by a short incision in the middle line or in the right or left groin, seizing the first piece of distended intestine that presents, and securing it to the wound by a double row of sutures and then opening it. It is employed in cases where the diagnosis of the situation of the obstruction is uncertain, or where it appears probable that it is in the small intestine or too high in the colon to be relieved by right colotomy, when the patient's condition is such that the severe shock and the prolonged manipulation that necessarily attends laparotomy (the operation otherwise indicated) would probably be fatal. It may also be employed in cases of obstruction due to contractions consequent upon the matting-together of the small intestines from chronic inflammation, cancer, &c. It should be thoroughly understood, however, that the operation is only intended to relieve the distension of the intestines and prevent their rupture. It does not attack the seat of obstruction. But by relieving the acute symptoms it may give time for a diagnosis in doubtful cases to be arrived at; and the patient's condition after it may so far improve as to allow of a more radical course of treatment being undertaken on a future occasion.

ENTERECTOMY consists in opening the abdomen and excising a portion of the small intestine. It may be required for irreducible intussusception, epitheliomatous stricture, gangrene from strangulation by bands, the closure of fæcal fistulæ, wounds of the intestine, &c. It may be done in two ways:—1. Open the abdomen as in laparotomy; draw the portion of intestine to be removed well out of the wound, and pack it round with moist antiseptic gauze; clamp or compress with the fingers the intestine above and below to prevent the escape of fæces; cut out the diseased or damaged part together with a wedge-shaped piece of the mesentery; tie all bleeding vessels; unite the mesentery by sutures, and secure both the proximal and distal portions of the intestine to the wound in the abdominal parietes by sutures. 2. After the mesentery has been sutured unite the two portions of intestine by sutures (Lembert's method, see page 389), so as to bring the serous surfaces into contact; and then drop the united intestine back into the abdomen. The first method is the one commonly best adapted for cases of abdominal obstruction, as it allows the distended gut to empty itself, and takes less time to perform. Further, as the gut above is usually distended whilst that below the damaged part is contracted, it is difficult to unite the two portions, and their walls, moreover, are inflamed and not in a favourable condition for union. When the first method has been employed a subsequent attempt to restore the continuity of the intestine may be made by destroying the spur-like projection between the upper and lower portions by Dupuytren's enterotome, and uniting the coats by sutures. See *Artificial Anus.*

LUMBAR COLOTOMY is the opening of the colon in the left lumbar region (*Callisen's operation*), or in the right (*Amussat's operation*). The former should be chosen when the disease is in the rectum or lower part of the sigmoid flexure; the latter when there is any doubt whether it may not be in the transverse colon. That on the left side, the common operation, need only be described. Place the patient on his right side, slightly inclining towards his face, with pillows under his abdomen, or beneath his loin, in order to make his left side prominent. The outer border of the quadratus lumborum, the guide to the colon, should then be marked: its outer border is situated half an inch posterior to a point midway between the anterior superior and posterior superior spines of the ilium. Then make an incision about four inches long between the last rib and crest of the ilium from the erector spinæ obliquely outwards and downwards. Divide the skin, fascia, and various layers of muscles, viz., the latissimus dorsi, external oblique, internal oblique, and transversalis, and the transversalis fascia on a director (Fig. 225), and the quadratus lumborum will now be exposed at the inner part of the wound, and may be known by its fibres running upwards and inwards. When the colon is distended it will bulge in the wound; when contracted, however, it may be sought in the wound by carefully scratching through the fatty tissue covering it with two pairs of dissecting forceps. If there is much difficulty in finding it, pass a small catheter, if practicable, though the stricture, and inflate the colon. The colon may be distinguished from the peritoneum, which sometimes presents in the wound, by its situation immediately external to the quadratus lumborum and below the kidney; by the presence of the longitudinal bands of muscular fibres; by the thickness of its coats on nipping it up by the fingers; and, at times by in this way feeling scybalous masses of fæces in its interior. The peritoneum, on the other hand, may generally be known by the absence of the above characters, and if it is nipped up, by the intestine being felt to slip away from between the fingers. Having found the colon, secure it to the skin. This is usually done by passing a silk suture by means of a curved needle on a handle, first through the skin, then through the bowel, and then through the skin on the opposite side of the wound, and repeating the procedure at the other end of the wound. The bowel is then opened in a longitudinal direction, the loops of suture by which it is transfixed hooked out by the finger and divided, and the bowel secured to the integument by the four sutures thus formed. A better and more convenient way of passing

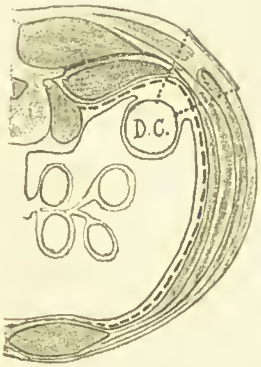


Fig. 225.—Diagram of parts divided in left lumbar colotomy.

the sutures, which should then be of wire, is by Smith's cleft palate needle. If this is used a series of sutures are passed, first through the skin, and then through the wall of the bowel, and tied before the bowel is opened. Should the peritoneal cavity be opened by mistake, it must be carefully closed by suture before the incision is made into the colon.

Some perform colotomy in two stages, like gastrostomy; but if the operation is carefully done in the way described above, such is hardly necessary. The bowels should be kept at rest by means of opium for four or five days, and no food given by the mouth for twenty-four hours. An enema may subsequently be required if the bowels do not act spontaneously. It may also become necessary to clear that portion of the bowel which is beyond the wound. Indeed it has been proposed to close completely this part of the bowel by operation so as to prevent fæces passing down it.

INGUINAL COLOTOMY is the operation of opening the sigmoid flexure of the colon in the left loin (*Littre's operation*). It has been much employod of late in place of lumbar colotomy, especially for carcinoma of the rectum before distension of the colon consequent on the stricture has occurred. The chief advantages claimed for it are: 1, that there is less difficulty in finding the gut; 2, that there is less danger of peritonitis, in that, as the peritoneum has to be opened, all proper precautions can be taken; 3, that the wound is more superficial, and consequently there is less risk of infiltration of the tissues and septic poisoning; and 4, that the groin is a moro convenient situation for an anus than the loin. An oblique incision (Fig. 224 d) about two inches long is made one inch from the anterior superior iliac spine at right angles to a line drawn from the umbilicus to the iliac spine, one inch of the incision being below and one inch above the line. Divide the skin, superficial and deep fascia, muscles, fascia transversalis, and peritoneum on a director. If the gut does not present in the wound carefully search for it with the fingers. It may be known by the longitudinal bands of muscular fibres, by the appendices epiploicæ, and by its mesentery running to the left, whereas that of the small intestine runs to the right. Having found the colon stitch tho parietal peritoneum to the skin, and then secure the gut to the parietal peritoneum by sutures passed through only the peritoneal and muscular coats.

Apply an antiseptic dressing, and at the end of some days, when adhesions have had time to form, cautiously open the gut. Some surgeons, for the purpose of forming a spur, and thus preventing the fæces from going down the distal end of the intestine, draw the gut forward by a ligature passed through the mesentery.

OPERATIONS AT TIMES REQUIRED FOR CERTAIN DISEASES OF THE LIVER, GALL-BLADDER, STOMACH, AND SPLEEN.

ASPIRATION OF THE LIVER may be required for the purpose of diagnosis in the case of a suspected hydatid cyst or abscess in the liver, or for the removal of the fluid from a hydatid cyst. Having thoroughly cleansed the skin with an antiseptic and placed the patient, if nervous, under an anæsthetic, introduce the aspirating needle at the most prominent part of the swelling, taking care to avoid the colon and intestines. When operating for hydatids stop the aspiration if blood escapes, if the patient becomes faint, or if violent cough comes on. Otherwise continue the aspiration till the cyst is exhausted. On the removal of the needle place an antiseptic pad over the wound. The operation is not free from danger, several patients having died suddenly on the introduction of the needle, apparently in some cases from plugging of the pulmonary vein by a portion of a hydatid that has escaped into the circulation through a wound of one of the hepatic veins.

INCISION OF THE LIVER may be required for evacuating a hydatid cyst, or abscess. Make an incision over the most prominent part of the swelling, and having divided the abdominal parietes and stopped all bleeding, open the abdominal cavity. If the liver is adherent to the abdominal walls carefully incise it, first introducing an aspirating-needle to determine the situation of the pus. If non-adherent the liver may be stitched to the abdominal wall and an aspirator introduced to determine the situation of the cyst or abscess, and the liver-substance then incised. Or the opening of the cyst or abscess may be delayed till the liver has become adherent to the parietes. Great care should be taken, if the cyst or abscess is opened at once, to prevent any fluid or pus escaping into the peritoneal cavity, and the strictest antiseptic precautions should of course be observed. Place a drain tube in the wound and apply antiseptic dressings.

TAPPING THE ABDOMEN FOR ASCITES should be done in the linea alba, midway between the umbilicus and the pubes (Fig. 224 a). The bladder having been emptied, a small incision should be made through the skin, and the trocar and cannula, with a tube attached to convey the fluid into a vessel, should be thrust into the abdomen. The fluid should be drawn off slowly, and a many-tailed bandage, previously passed round the body, gradually tightened as the fluid flows, in order to keep up pressure on the abdominal vessels, and so prevent syncope.

CHOLECYSTOTOMY is the opening and draining of a distended gall-bladder, consequent upon the impaction of a calculus in the cystic duct. Make an incision in the linea semilunaris, beginning about two inches below the costal cartilages (Fig. 224 f). Having divided the abdominal parietes and stopped all bleeding, open the peritoneum. Search for the gall-bladder with the finger if it does not present in the wound, and bring it to the surface. Pack the wound with sponges to prevent any fluid escaping into the peritoneal cavity, and introduce an aspirator-needle into the gall-bladder, which, as the fluid escapes, should be well drawn into the wound. Enlarge the opening in the gall-bladder and remove any gall-stones found loose. If a stone is found impacted in the cystic duct, extract it, if possible, by forceps, by gentle manipulation with the fingers in the abdomen, by careful crushing with padded forceps, or by chipping off fragments as it lies in the duct. Secure the edges of the aperture in the gall-bladder to the abdominal wall by sutures with its peritoneal coat well in contact with the parietal peritoneum; leave a drain-tube in the gall-bladder; and close the rest of the abdominal wound in the way already described. The biliary fistula thus left will close in a few weeks if the cystic duct has been cleared.

CHOLECYSTECTOMY, or extirpation of the gall-bladder, may be required: 1, where perforation following suppuration and ulceration has occurred, and the coats are found too softened to admit of suture; and 2, where cholecystotomy is indicated, but on opening the abdomen the gall-bladder is found so contracted that its fundus cannot be drawn into contact with the abdominal walls without tearing it. Make an incision similar to that for cholecystotomy, prolonging it or dividing the muscles transversely a little below the ribs if more room is required. Having well packed the wound with sponges to prevent blood escaping into the general peritoneal cavity, dissect the gall-bladder from the liver, clamping or tying any bleeding vessels, divide the cystic duct between two ligatures, cleanse the wound, remove the sponges, and unite the abdominal walls in the usual way.

PYLORECTOMY, GASTRO-ENTEROSTOMY, DUODENOSTOMY AND JEJUNOSTOMY.—*Pylorectomy*, or the operation of removing the pylorus for carcinoma, and uniting the severed duodenum to the stomach by suture; and the substitutes for this operation, viz. :—*gastro-enterostomy*, or the operation for forming a fistula between the stomach and small intestine to allow fluids to pass out of the stomach; and *duodenostomy* and *jejunostomy*, or the operations for forming an artificial opening into these portions of the small intestine respectively, have hitherto been attended with such fatal results, and are so rarely justifiable that they are not here further described. Neither is the operation of opening the stomach, securing it to the abdominal walls, and then scraping away with a curette portions of the carcinoma blocking the pylorus; although from the success attending it as a palliative in the few cases in which it has been done it is possible that it will take the place of the above-mentioned operations.

SPLENECTOMY, or extirpation of the spleen may be required for rupture of the viscus, and for some cases of hypertrophy. An incision is made either in the linea alba, the linea semilunaris, or, still further to the left, and the spleen having been thoroughly exposed, adhesions carefully broken down, and the organ, if enlarged, drawn out of the wound, the pedicle is transfixed in several places, and the ligatures interlocked and tied. The pedicle is next severed well to the splenic side of the ligatures, the organ removed, the peritoneum thoroughly cleansed, and the abdominal wound united and drained. Great care should be taken not to tear the splenic substance, an accident attended with fearful hæmorrhage.

DILATATION OF THE CARDIAC AND PYLORIC ENDS OF THE STOMACH FOR SIMPLE FIBROUS STRICTURE (*Loreta's operations*) consists in opening the stomach and then dilating the cardiac or pyloric end, as the case may be, with the finger. The wound in the stomach is then closed by a Lembert's suture, and the abdominal parietes united, as after ovariotomy. Tho strictest antiseptic precautions must of course be taken. In the successful operations there has been no return of the stricture at present.

HERNIA.

The term Hernia, though often used in conjunction with other terms to signify the protrusion of any viscus from its containing cavity, as "*Hernia cerebri*," or "*Hernia testis*," when employed alone is applied only to such a protrusion from the abdomen or pelvis, and is equivalent in this sense to the term Rupture, the name by which the affection is popularly known.

DESCRIPTION OF HERNIA IN GENERAL.—A hernia may occur at almost any situation, but is most common at the inguinal and femoral rings, spots at which the abdominal parietes are naturally weaker than elsewhere. It generally consists of intestine, or of omentum, or of both; but almost every one of the abdominal or pelvic viscera have at times formed the protrusion.

THE CAUSES OF HERNIA are predisposing and exciting. *The predisposing* may be divided into: 1. Hereditary and congenital malformations, such as an elongated condition of the mesentery, a patency of the funicular portion of the tunica vaginalis or canal of Nuck, and congenital defects of the abdominal parietes. 2. A relaxed condition of the abdominal muscles, such as is induced by pregnancy, and by rapid emaciation in persons previously stout. 3. The rapid formation of fat in the omentum or mesentery. 4. Any injury or operation that has weakened the abdominal walls. 5. Occupations involving severe muscular exertion; and 6. The male sex, inasmuch as men are more subjected to the exciting causes. *The exciting causes* are such as produce a diminution in the size of the abdominal cavity by the contraction of the muscles forming its walls and the consequent compression of the contained viscera. They may be divided into those that act suddenly, and those that act slowly. Amongst the former may be mentioned sudden and violent exertions, straining at stool, lifting heavy weights, &c. Amongst the latter, continual straining, as from stricture of the urethra, enlarged prostate, phimosis or a narrow meatus, constant coughing occasioned by chronic bronchitis and emphysema, &c.

ANATOMY OF HERNIA.—As the viscus is protruded through the abdominal or pelvic parietes, whether at one of the so-called rings or elsewhere, it generally forces that portion of the parietal peritoneum which lies over the aperture before it in the form of a pouch. When it escapes at the internal inguinal ring, however, instead of thus protruding the peritoneum in front of it, it may pass into the tubular prolongation of peritoneum which naturally descends in front of the testicle in the fœtus, and which from some cause has remained unobliterated. The pouch of peritoneum in which the protruded viscus is thus enclosed is called the sac. In the former case it is spoken of as an *acquired*, in the latter as a *congenital* sac. In some forms of cæcal hernia the sac may be incomplete, *i.e.*, the viscus may be only covered by peritoneum in front, and in contact with the tissues behind; and in diaphragmatic hernia, and in hernia following a wound of the abdominal walls where there is no parietal peritoneum covering the aperture, there will be no sac. The protruded viscus enclosed in its peritoneal sac forms a swelling surrounded by the tissues of the part into which it has escaped. The tissues superficial to it, *i.e.*, between the sac and the skin, form what are called its coverings. We have to consider, therefore, 1, the sac, 2, its contents, and 3, its coverings.

1. The *sac* is said to consist of a body, neck and mouth, terms which sufficiently explain themselves. It is at first thin and membraneous, resembling the peritoneum; but in old herniæ may become thickened and indurated, or else, as for example in umbilical hernia, attenuated or in places absorbed. It is usually globular or pyriform, but may take almost any shape. Thus it may be fusiform, hour-glass-like, or divided by adhesions into two parts, the lower part, perhaps, containing fluid and forming what is known as a hydrocele of the sac. The neck is at first generally slightly puckered, but as the result of inflammatory consolidation becomes in old herniæ smooth, thickened, and often indurated. The mouth may be wide and expanded, or, in the case of congenital herniæ, in which the neck is frequently elongated, narrow and contracted.

2. The *contents of the sac* may be intestine alone (*enterocele*); or omentum alone (*epiplocele*); or both, the omentum then generally descending in front of the intestine (*entero-epiplocele*), or more rarely the intestine in front of the omentum (*epiplo-enterocele*). In exceptional instances the bladder, the ovaries, and other of the abdominal or pelvic viscera, have been met with in the sac. The small intestine, and especially a portion of the lower three feet of the ileum, most frequently escape. When the large intestine descends it is generally the cæcum; but any

portion of the small or large may do so. There may be but a small knuckle of intestine in the sac, or a part only of its calibre; but when once a portion has descended there is generally a tendency for more to follow, and in old herniæ to the extent of several inches or even feet. The protruded intestine and mesentery in long-standing cases become hypervascular and thickened, and the omentum hypertrophied and matted together. A small quantity of serous fluid is also generally found in the sac, and in rare instances loose or attached fibrinous bodies somewhat similar to those met with in bursæ. Where the neck of the sac has become obliterated by the long wearing of a truss, the sack has been found filled entirely with serous fluid, thus forming a cyst.

3. The *coverings of the sac* necessarily vary according to the situation of the hernia. They will be enumerated under each special form, and little more need be said about them here further than that they often become thickened, blended together, thinned, or absorbed, so that in actual practice they cannot always be demonstrated.

THE CONDITIONS OF A HERNIA.—A hernia may be: (1) reducible; (2) irreducible; (3) strangulated; (4) incarcerated, and (5) inflamed.

1. A REDUCIBLE HERNIA is one that can be returned into the abdominal cavity, *i.e.*, it either goes back when the patient lies down; or it can be made to do so by the patient himself, or by the Surgeon making pressure upon it in a suitable direction. The sac, except perhaps in quite recent cases, cannot be put back into the abdomen in consequence of its adhesions to the surrounding tissues, but remains empty *in situ*.

Symptoms.—At first there may be a mere fulness or protrusion, commonly at one of the abdominal rings; the protrusion becomes more prominent when the patient stands up, strains, or coughs, but it completely disappears on his lying down. If neglected, it gradually increases in size, forming a prominent non-translucent swelling, in which a distinct impulse is felt on coughing. If the hernia contains intestine (*enterocele*), it will be tense and elastic, and resonant on percussion; whilst a peculiar gurgling is heard from the displacement of gas and fluid on returning it into the abdomen. If on the contrary it contains omentum (*epiplocele*), it will be dull to percussion, doughy and inelastic, or hard and resisting, and lobulated, whilst the characteristic gurgling is not heard on returning it into the abdomen.

The *diagnosis* will be given under the head of *Special Herniæ*, as it is from other diseases of each special region that a diagnosis has to be made.

The *treatment* may be palliative or radical. The *palliative* treatment consists in reducing the hernia and applying a pad and spica bandage (Fig. 226), till a truss can be procured. The form of truss will vary according to the position, size, etc., of the hernia. Fig. 227 is an inguinal truss of the ordinary shape, and may be distinguished from a femoral (Fig. 228), by the pad of the latter being placed more vertically. Fig. 229 is an umbilical truss. In measuring for a truss the following notes should be

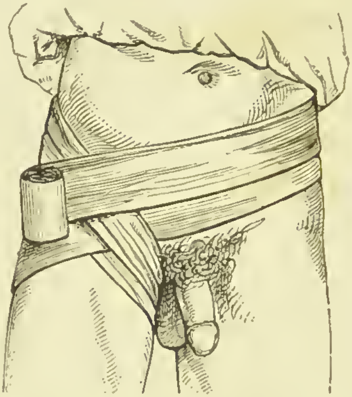


Fig. 226.—Spica bandage for the groin. (Bryant's Surgery.)

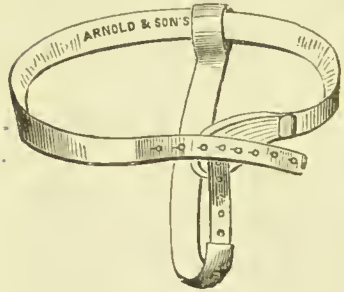


Fig. 227.—Inguinal truss.

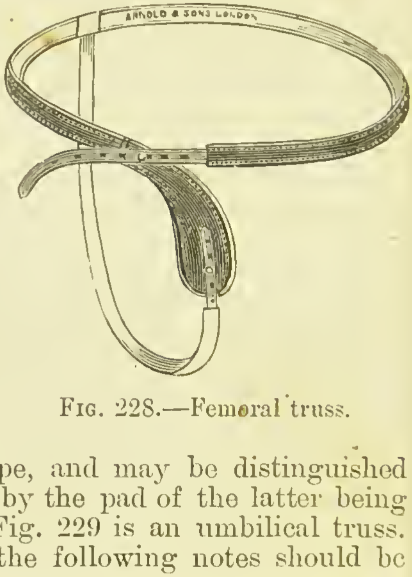


Fig. 228.—Femoral truss.

taken and sent to the maker :—1. The dimensions round the pelvis midway between the crest of the ilium and the great trochanter. 2. The kind of hernia. 3. The side on which it is situated. 4. The size of the ring. 5. The age and sex of the patient. 6. The strength of the spring required. The truss should be worn constantly, and never on any excuse left off. A lighter truss may be provided for the night, and one covered with india-rubber or made of vulcanite for the bath. The *radical* treatment consists in reducing the hernia, and in some way obliterating the sac and closing the ring. In young children the wearing of a truss may do this, but in older children, and in adults, the ring is then usually too large and otherwise altered for the hernia to be thus cured, and some further procedure, if thought advisable, must be undertaken. Of the various methods that have been proposed, those of Wood, Spanton, Warren, and Banks, are, perhaps, the most in vogue at the present time. Briefly, 1. Wood's consists in freeing the sac from its scrotal connections, invaginating it into the inguinal canal, and then subcutaneously sewing the canal, ring, and sac together. 2. In Spanton's, the sac is also invaginated, but the consolidation of the parts is effected by twisting them together by an instrument shaped something like a cork-screw which is introduced subcutaneously, and left *in situ* for a week or ten days, or until sufficient inflammation has been set up to glue the parts together. 3. Warren and Heaton, amongst others in America, have revived the method of obliterating the sac by injections. 4. Banks' method consists in cutting away the sac after ligature of its neck, and then sewing up the ring. Ligature and excision of the sac is applicable to femoral and umbilical as well as to inguinal hernia. In femoral hernia, however, the ring is too unyielding to admit of its being closed by suture.

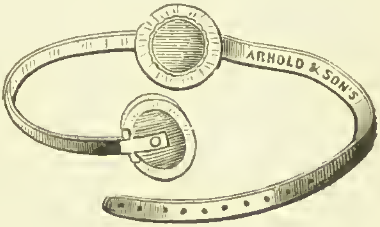


FIG. 229.—Umbilical truss.

2. AN IRREDUCIBLE HERNIA is one that cannot be returned into the abdomen.

The *causes* of the irreducibility, which are many, may be conveniently classified according as the impediment to the return of the contents of the sac exists:—1. *Outside the sac*, from inflammatory thickening and contraction of the tissues forming the ring or other aperture through which the hernia has escaped. 2. *In the sac walls*, from inflammatory thickening and contraction, and elongation of the neck of the sac. 3. *Inside the sac*, from (*a*), the great bulk of the intestine or omentum due to increased growth subsequent to their descent; (*b*), constriction of the omentum at the situation of the ring and expansion of the lower part; (*c*), adhesion of the intestine or omentum to the sac, or to one another; (*d*), bands of adhesions stretching across the sac and so confining a loop of intestine or knuckle of omentum; (*e*), a collection of fluid in the sac; (*f*), a portion of intestine having descended uncovered with peritoneum on one aspect, the uncovered portion forming adhesions with the tissues around it where the sac is absent.

The *symptoms* are similar to those of the reducible form, save that the hernia cannot be completely reduced. Thus, there is impulse on coughing, non-translucency, and when it contains intestine, gurgling on handling, and resonance on percussion. It is, moreover, often attended with dragging or colicky pains and dyspeptic symptoms. When its contents are both intestine and omentum, the intestine can sometimes be returned. A consideration of the above signs should serve to distinguish it from a hydrocele extending high up the cord with which it is perhaps most likely to be confounded.

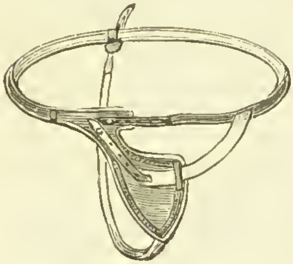


FIG. 230.—Bag truss for irreducible hernia.

Treatment.—An irreducible hernia often attains a large size, and is not only on this account a constant source of annoyance to the patient, but is also one of danger as there is always a risk of its becoming obstructed, strangulated, or inflamed, or ruptured by accidental blows, etc. The treatment may be directed to one of two ends: 1, to protect it from injury and prevent it from getting bigger by the descent of more intestine or omentum; and, 2, if possible, to render it reducible. For the first purpose the patient should wear a bag truss (Fig. 230), or the lace-up truss. Trusses aro often difficult to adjust. Under such circumstances a cast of the parts should be taken in plaster-of-Paris, and to this any instrument-maker can then accurately mould the truss. When the patient will submit, an attempt may be made to convert the hernia into a reducible one; and if persevered in will frequently, especially in recent herniæ, be successful. The patient should maintain the horizontal position, the diet should be restricted, saline purgatives given, and ice occasionally applied to the part. The treatment will, of course, only be successful where the irreducibility depends upon removable causes, such as an increase in the bulk of the omentum or intestine. Where it is due to adhesions and the like, it cannot obviously be cured in this way. The question of an operation for a radical cure may then be raised.

3. STRANGULATED HERNIA.—This form of hernia is one in which the protruded portion of intestine or omentum is so tightly gripped, that not only is its return into the abdomen prevented, but the circulation through its blood-vessels is so impeded, that congestion, followed by inflammation and gangrene, speedily ensues, if the strangulation is not soon relieved.

Causes.—1. The sudden forcing of intestine or omentum through a ring or aperture so small that it is tightly gripped from the moment of its descent. This is usually the cause of strangulation in a recent hernia or in an old hernia which has suddenly descended through the patient's neglect to put on his truss. 2. The increase of bulk in the hernia subsequent to its descent, and its consequent constriction where it passes through the aperture or ring. This is usually the cause of strangulation in irreducible hernia, or in herniæ that have not been kept up by a truss. Such an increase in bulk may be induced by: (*a*), the sudden protrusion of a fresh portion of omentum or intestine on the top of that already down; (*b*), the swelling of the intestine from catarrhal inflammation of the mucous membrane, or from its becoming obstructed by fæces or flatus; and (*c*), congestion and inflammation of the omentum.

The *seat of constriction*, or as it is technically called the *stricture*, is generally either (1), *outside the sac*, *i.e.*, at one of the tendinous rings, or other aperture through which the hernia has passed; or (2), *in the neck of the sac itself;* whilst (3), in very rare instances, it may be *inside the sac*, the intestine having slipped through a hole in the omentum, or become entangled by a band of adhesions.

Mechanism of strangulation.—The compression of the veins at the seat of stricture impedes the return of venous blood from the protruded portion of intestine or omentum, and congestion followed by inflammation and gangrene ensues more or less quickly according to the completeness of the obstruction. The congestion, moreover, induces paralysis of the muscular coat, and consequent cessation of its peristaltic action and the onward flow of the intestinal contents. For strangulation to occur it is not necessary for the whole circumference of the bowel to be included in the stricture. An inclusion of only a small portion of its circumference (*Littre's Hernia*), in consequence of the venous congestion and subsequent inflammation which it induces, is sufficient. Indeed, symptoms of strangulation are said to occur when omentum only is contained in the hernia, a fact somewhat difficult to explain, as constriction of omentum by a tight ligature certainly gives rise to no symptoms. It is possible that in these cases the signs of strangulation have depended on reflex irritation of the omental nerves, or on a small knuckle of intestine having been strangulated at the neck of the sac and slipped back unperceived. That strangulation may produce a severe impression on the nerves, is evidenced by the pain reflected to the umbilicus, and the general nervous symptoms.

Pathological condition of the strangulated part.—When the constriction is very tight, the circulation may be completely arrested, and gangrene ensue in a few hours. But as a rule the arrest is only partial, and the gangrene is preceded by congestion and inflammation. The intestine at first appears red, and, perhaps, slightly swollen, but not otherwise altered; whilst clear serous fluid in greater or less quantity is poured out between it and the sac. It next assumes a mulberry colour, and as the congestion increases it becomes darker and darker, and finally black or ash-grey. At the same time it becomes more swollen, and loses its bright shining appearance, becoming sticky, then doughy in consistency, and pitting on pressure, whilst the fluid gets darker and turbid, and feculent in odour; finally, the intestine sloughs, and its contents are extravasated into the sac. Sloughing or ulceration frequently begins at the seat of stricture, and in the mucous coat, where, even at an early stage, an impression of the stricture is often seen. The omentum undergoes similar changes, passing gradually into a state of gangrene. The intestine above the strangulated portion for a variable distance is congested and distended with fæcal matter, whilst that below is empty and contracted, but otherwise natural. Simultaneously with these changes a local peritonitis is set up about the neck of the sac, gluing the intestine to the peritoneum, so that as a rule there is no extravasation into the peritoneal cavity. The sac becomes inflamed, a fæcal abscess is formed, and, if the patient survives, opens on the surface, leaving him with a fæcal fistula. In other cases general peritonitis supervenes, or the intestine gives way above the stricture and so peritonitis results.

The *symptoms* are local and general. *Local symptoms.*—The hernia, if previously reducible, is no longer so; it becomes tender or painful on handling, tense, and often tympanitic; and the *impulse on coughing* is lost. Pain may be present in the hernia, but is generally referred to the region of the umbilicus. The skin is usually natural, but where gangrene has occurred, it may become mottled, or brick-dust red, and emphysematous, and exhale a fæcal odour. Cessation of pain may then occur, but is a delusive sign. The *general symptoms* are those of intestinal obstruction, the two chief being vomiting and constipation. The vomiting is of a peculiar gushing character, with little or no retching. The vomit at first consists of the contents of the stomach, but soon becomes bile-stained, and finally fæcal, *i.e.*, thin and brownish-yellow, with a distinct odour of fæces. The constipation is *complete* (except in Littre's hernia), flatus not even passing, although at first the contents of the large intestine may be voided, either naturally or by an enema. The face becomes pinched and anxious, the pulse small and wiry, the tongue furred and brown, and if strangulation is not relieved, the patient may die of collapse, general peritonitis, or exhaustion from constant vomiting. Very occasionally a fæcal abscess may form and the patient recover with a fæcal fistula. Space will not permit of a description of the variations in the symptoms that may be met with, and it must suffice to say that as a rule in young patients with recent hernia they are more acute, and call more imperatively for immediate relief than in older patients, the subjects of irreducible hernia of long standing in whom they assume a more chronic character.

Treatment.—It cannot be too strongly impressed on the mind of the student that it is of vital importance to release the strangulated intestine; that this as a rule admits of no delay; that every hour adds to the danger; that the result of the case will depend to a great extent upon the length of time the strangulation has existed; that purgatives for overcoming the obstruction are not only useless, but absolutely injurious; and that prolonged and forcible attempts to return the bowel by the taxis are unjustifiable and wholly to be condemned. What should be done, therefore, in a case of strangulated hernia? The taxis should as a rule be applied for a few minutes; if this is unsuccessful the patient may in some forms of inguinal hernia be placed in a warm bath for twenty minutes, and another attempt then made to return the bowel. This failing, he should be placed under chloroform, and should the bowel then not slip back readily on again gently trying the taxis, the operation for dividing the stricture should *at once* be proceeded with before he is allowed to recover from the anæsthetic. If the Surgeon is not prepared for the operation, or requires help, a full dose of opium should in the meantime be given, and ice, if at hand, or warmth in the form of a large poultice, be applied to the tumour. But it is better not to attempt the reduction under chloroform till prepared to proceed with the operation. We have then to consider the method of applying the taxis, the cases in which it should not be used, the cases suitable for the hot bath, and the operation of herniotomy.

The taxis.—The method of applying the taxis, which is merely the technical term given to the various manipulations used in returning the hernia into the abdomen, can only be learned by practice. The pelvis should be slightly raised, and the thigh in femoral hernia flexed and adducted so as to relax as much as possible the constricting ring. With one hand, slightly raise the hernia, and grasp it gently so that some of the flatus or fluid may be squeezed out and the bulk lessened. With the finger and thumb of the other hand, gently compress the neck laterally to prevent its bulging over the margin of the ring, and at the same time draw the hernia a little downwards to disengage its neck. The pressure should be applied steadily, not spasmodically, and its direction varied according to the kind of hernia. No violence should be used, and if after a few minutes the intestine does not slip back with the characteristic rush, further attempts should not be made. Violent or prolonged efforts are strongly to be condemned, as not only are they unlikely to be successful, but may lead to the rupture of the intestine, or stopping short of this may cause so much bruising, ecchymosis, or inflammation, that they jeopardize its recovery after operation. How long should the taxis be applied? Certainly not more than ten minutes at the outside. The length of time, however, may vary in different herniæ. Roughly it may be given at about two minutes for a small tight femoral hernia, and five minutes for a large femoral, inguinal, or umbilical hernia. It should be remembered that the taxis is more successful in recent than in old femoral herniæ; in inguinal than in femoral, and especially in old inguinal under chloroform; and that when successful it is the safest method of overcoming the strangulation. The taxis should not bo applied—1, when other Surgeons have already employed it for long periods; 2, when the hernia is very tense, tender, or inflamed; 3, in femoral hernia where fæcal vomiting has existed for some time, or where hiccough has supervened;—in short, whenever it appears questionable whether the intestine has not passed into a condition beyond recovery, or whether actual gangrene has not taken place.

The *hot bath* is more likely to succeed in acute than in chronic cases, and in young muscular patients, and in inguinal herniæ. It should not, as a rule, be given to the old or feeble, as it has a tendency to induce faintness, and renders them liable to take cold. Little can be expected from it in femoral hernia on account of the fibrous and unyielding nature of the ring.

The operation.—Herniotomy or kelotomy has for its object—1, the liberation of the strangulated intestine or omentum by dividing the stricture, and 2, the returning it into the abdomen if proper or possible. The parts having been shaved and thoroughly cleansed with some antiseptic lotion, an incision should be made over the sac in the long axis of the tumour, and its coverings carefully and successively divided upon a director till the sac is exposed, any bleeding vessels being tied. The sac may be known by the arborescent arrangement of its vessels, its tenseness and smoothness, and when thin by intestine, omentum, or fluid being seen through it. It may further be distinguished from the intestine by the shining appearance of the latter, by the circular arrangement of the intestinal vessels, and by a little fluid usually escaping when the sac is opened. If still in doubt, the questionable structure should be picked up with the thumb and fore-finger if not too tense, when, if it is sac, the intestine will be felt to slip away. If it is the Surgeon's intention to attempt to return the hernia without opening the sac, the neck should be fully exposed, and the finger-nail having been inserted beneath any tense band that can be felt, this should be divided by the hernia knife (Fig. 231). As small a notch as possible compatible with the easy return of the hernia should be made; and it is better to make two or three slight notches than one large one. Gentle pressure should now be made upon the hernia to see if it can be returned. Should it slip back, the Surgeon's object has been attained. The neck of the sac may then be ligatured, the rest of the sac cut away, the ring sewn up, the wound brought together with sutures, dressed, and a spica bandage applied. But the hernia cannot always thus be reduced; and further, it is not always proper to attempt it. Under such circumstances the sac must be opened. Before describing the method of doing this, let us consider the conditions that should guide us in the matter. Broadly it may be said that whenever it is right to apply the taxis before operation, it is also right to try and return the hernia without opening the sac; and conversely that when the taxis is considered unjustifiable, it is also unjustifiable not to open the sac. The *sac* then should be *opened*: —1. When the stricture is at the neck and the hernia cannot be reduced without opening it. 2. When the hernia is known to be irreducible, or only partially reducible. 3. When any doubt exists as to the condition of the intestine. 4. When the symptoms point to gangrene having already occurred. 5. When rupture of the intestine is suspected from the hernia having suddenly collapsed or yielded unaccompanied by signs of reduction. 6. When it is thought that the hernia has been displaced or reduced *en masse*. It need hardly be said that in opening the sac, as in so doing the peritoneal cavity and the intestine or omentum is exposed, the risks of the operation are some-

Fig. 231.—Cooper's hernia knife.

what increased, although these have been greatly lessened by the advances in modern surgery. Having determined, therefore, to open the sac, every antiseptic precaution in the widest sense of the term should be taken. All bleeding should be stopped, the parts thoroughly cleansed with carbolic lotion, the Surgeon's hands and his assistant's cleansed from blood, and the instruments the same. A piece of the sac should be nipped up with the forceps, and nicked with the blade of the knife held on the flat. If too tense to allow of this, it must be cautiously scratched through with the point of a knife. As a rule there is no danger of injuring the intestine, as some fluid generally exists between the sac and its contents. The sac, however, should always be opened with care, as the intestine may be in contact with it. If omentum is seen shining through the sac, it should be opened opposite that spot. The character of the fluid which escapes is a good criterion of the condition of the parts. If pale and serous, the indication is good; if blood-stained and turbid or fæcal in odour, bad. A director should now be passed through the small opening, and the sac laid open, the fluid absorbed by sponges to prevent it running into the abdomen, and the contents examined. If only omentum presents, this should be gently unravelled to search for intestine, a small knuckle of which will often be found near the neck of the sac. The questions will now arise what shall be done with the intestine, what with the omentum? Shall they, or can they be returned? shall the omentum be cut off? shall the stricture be divided?

Treatment of the intestine.—If the intestine is merely congested and claret-coloured but still shining and the fluid in the sac is of a serous character there can be no question of replacing it in the abdomen; or if it is already gangrenous (a condition that may be known by its ash-grey colour, loss of elasticity and not bleeding if pricked), there can be no question on the other hand of leaving it where it is or of cutting it away. Again, if it is adherent to the sac the adhesions when soft and recent may be gently broken down with the finger and the intestine returned unless such is contra-indicated from other causes; or when the adhesions are old and fibrous, they may be cut through and ligatured, and the intestine also returned; but when they are thick and fleshy, the intestine must be left in the sac, as any attempt to break them down would probably lead to the tearing of its walls. In cases as the above the treatment is clear; but when the intestine is black, ecchymosed, flaccid, sticky, or coated with lymph, it becomes an anxious moment for the Surgeon to decide what to do with it, and much must be left to his own judgment in each individual case. As a general rule it may be said that when only a small knuckle is present it should be replaced just within the ring, so that if it gives way the fæcal contents may escape externally; but that when a large coil is present it should be left in the sac. Some Surgeons, however, if in doubt always leave the intestine in the sac and further draw down the loop to see if ulceration has occurred at the seat of constriction, when if such is the case they do not return it. If the gut is clearly gangrenous and distended, it should be opened; or if extensively gangrenous, the dead portion cut away and the open ends of the gut stitched to the wound. Cutting out the gangrenous portion, uniting the intestine above and below, and then returning it, is a procedure that can only be called for in the most exceptional cases. The coats are already inflamed and softened and their vitality is lowered, while the upper portion is distended with fæcal matter and the lower contracted; the patient's condition, moreover, is unfavourable for operation. Should the intestine be accidentally wounded either in opening the sac, or, as more commonly happens, in dividing the stricture, the edges of the wound should be united in the way described at page 388.

Treatment of omentum.—When small in amount, recently protruded, and only slightly congested, the omentum should be returned. When large in amount, thickened, inflamed, or gangrenous, it should be ligatured, cut off, and the stump returned into the abdomen. Carbolized silk is the best material for ligaturing the omentum. Catgut is unreliable, and has been followed by hæmorrhage. The ligature should be tied very tightly to prevent it slipping, the pedicle, if necessary, being gently pulled down to ensure its application at a healthy spot. When the omentum forms a large mass it should be carefully unravelled to determine the absence of intestine in its midst, and then tied in separate portions. Ligature of the vessels separately is unsafe, as some may be missed, and hæmorrhage occur into the peritoneal cavity. The carbolized silk ligatures should be cut off short and returned with the omentum. They become encysted and cause no irritation. If the omentum is adherent to the intestine it may be gently separated from it or returned with the intestine. If adherent to the sac it may be separated and returned or removed with the latter.

Division of the stricture at the neck of the sac.—Pass the index finger gently between the intestine and the sac, or if the omentum is spread out between the intestine and the sac (forming the so-called *omental sac*) between the intestine and omentum. The stricture having been discovered insinuate the finger-nail gently under it, and the intestine being held aside by the other fingers or by an assistant, pass the hernia knife, held with its blade on the flat and protected by the pulp of the finger, beneath the stricture, turn its cutting edge towards the stricture, and notch the latter in one or more places by gently depressing the handle. The direction in which the notch should be made will depend upon the situation of the hernia; in extent it should be as limited as possible. The Surgeon, as a rule, will do better to employ his finger than the director, as there is much less risk of wounding the intestine, but if a director is used it should be broad and flat (Fig. 232).

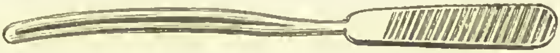


Fig. 232.—Wormald's hernia director.

If it is found that the stricture is not sufficiently divided to allow the intestine to slip back on being manipulated with the fingers, a second notch should be made. But if the intestine does not then return easily the stricture should be divided again, as no force must be used. Where the intestine is gangrenous it is, as a rule, better to slightly notch the stricture, taking care, however, to disturb as little as possible the adhesions that have formed between the intestine and the neck of the sac, as it is upon these cutting off, as they do, the general peritoneal cavity from the sac that the patient's safety depends. The division here is not practised for the purpose of relieving the strangulation, as the bowel is already dead; but for the purpose of allowing the contents of the bowel above the gangrenous part to escape externally.

Treatment of the sac.—The next question that arises is what should be done with the sac? My own practice has been, unless otherwise contraindicated, to dissect up the sac, apply a stout catgut ligature to its neck, and cut the body of the sac away. In *inguinal* hernia the ring may then be brought together with kangaroo-tail tendon, carbolized silk or silver sutures, a drainage-tube placed in the wound, and the latter closed. In *femoral* hernia the parts are so rigid that they cannot well be brought together. In *umbilical* hernia the sac and the redundant integuments may be removed, the edges of the ring refreshed, and the wound united by deep and superficial sutures. Many, however, prefer simply to leave the sac *in situ*, merely uniting the wound, and applying a pad. The sac should not be ligatured and cut off:—1. When the patient is weak or collapsed, and it is desirable to complete the operation with as little delay as possible. 2. When the sac is acutely inflamed. 3. When the intestine is in that doubtful condition that it has only been placed just within the ring. 4. When the abdomen contains much serous fluid, or peritonitis is present.

After-treatment.—The wound should be dusted with iodoform, dressed antiseptically, and a spica bandage applied. Half a grain of morphia may then be injected subcutaneously, or a full dose of opium given by the mouth, and the patient subsequently kept under the influence of the drug, in order to place the intestine at rest till it has had time to recover from the effects of the inflammation. To further insure rest some wash out the stomach with the stomach-pump. With the same end in view no nourishment should be given by the mouth for the first day or two, but ice in small quantities may be sucked to relieve thirst and allay any tendency to vomit, and nutrient suppositories or enemata after the first twelve hours may be given by the rectum. Subsequently milk in small quantities at a time may be taken by the mouth, then, in addition, beef-tea; but no solid food should be allowed till the bowels have acted. This they should be permitted to do spontaneously, as no harm will ensue should they continue confined for ten days or more. If at the end of this time any distension or uncomfortable sensations are experienced, an enema may be given. Such, however, in my experience is seldom required.

Conditions that may give rise to a continuance of the symptoms of strangulation after the taxis or herniotomy.—As a rule the symptoms of strangulation cease immediately or soon after the successful application of the taxis, or the operation for the division of the stricture. Should they persist, they may depend on—1. The effect of the anæsthetic. 2. Paralysis of the muscular coat of the intestine. 3. The presence of another hernia. 4. The displacement of the hernia, or reduction *en masse.* 5. The gut becoming gangrenous and giving way. 6. Enteritis or peritonitis. 7. Internal strangulation of the intestine. If the persistence of the symptoms is due to the anæsthetic they will usually pass off in a few hours. The vomiting, moreover, is usually attended with much retching, and is not of that gushing nature characteristic of strangulation of the bowel. If due to paralysis of the muscular coat of the intestine, the symptoms will also, as a rule, gradually cease under the influence of opium. Should they not do so, however, a careful search should be made, if this has not already been done, for another hernia, and if one is discovered and appears strangulated, it should be explored. If no other hernia exists the continuance of the symptoms may be due to the hernia not having been properly reduced, to peritonitis, to the persistence of the paralysis of the muscular coat of the gut, or to internal strangulation. If, therefore, the hernia is reported not to have slipped back with the usual gurgle, or there is some fulness felt about the hernial ring, the ring must be cut down upon and explored, or the wound, if an operation has been performed, opened up. It may then be found (*a*) that the hernia has been reduced *en masse*, *i.e.*, that the hernia, along with the sac, has been forced between the fascia transversalis and the peritoneum, a condition most frequently met with when the hernia is femoral; (*b*) that the neck of the sac has become detached, the intestine remaining strangulated; (*c*) that the posterior part of the sac has been rent and the hernia, still strangulated at the neck, forced into the sub-serous connective tissue, or (*d*) that the hernia has passed into a pouch at the neck of the sac instead of into the peritoneal cavity. Under any of the above circumstances the sac should be drawn down, the condition causing the strangulation accurately ascertained, the stricture, wherever situated, divided, and the intestine returned into the peritoneal cavity. Peritonitis following the reduction of a hernia may be known by the signs already given at page 391, and should be treated as there indicated. Persistent paralysis of the muscular coat, or the existence of internal strangulation, may be suspected when along with the continuance of the symptoms of strangulation of the bowel the signs of the other conditions that may give rise to such symptoms, are absent. Should the paralysis not pass off under the influence of time and opium, an enema, or even a purgative may, in some cases, be useful to rouse the intestine to action, whilst, in other instances, it may become necessary to explore the abdomen, open the intestine above the paralyzed part and suture it to the wound in the parietes. Internal strangulation should be treated as described under *Laparotomy*.

Prognosis.—The prognosis in a case of strangulated hernia will depend on the length of time the hernia has been strangulated, the tightness of the stricture, the presence or absence of gangrene or peritonitis before the operation, the amount of bruising inflicted on the gut by the taxis, the degree of exposure and manipulation to which the gut is subjected during the operation, and the general condition of the patient. Moreover, the prognosis is graver in a small femoral hernia, and in a hernia which has recently come down (inasmuch as in these the constriction is usually tight), than in an oblique inguinal hernia, or a hernia of long standing, in which the constriction is usually much less.

4. OBSTRUCTED OR INCARCERATED HERNIA.—These terms are generally applied synonymously to an irreducible hernia in which the protruded intestine has become obstructed by a collection of undigested food, foreign bodies, as cherry-stones, &c. The hernia is most frequently met with in old people, and if neglected, is apt to become strangulated or inflamed. *Symptoms.*—As in strangulation, there may be constipation, colicky pains, nausea, and perhaps vomiting ; but the local signs of strangulation are less marked. Thus, there may be little or no local pain and no tension in the sac, though, at times, it may become distended and larger than before the incarceration occurred. The impulse on cough may still be present, and hard fæcal masses may, perhaps, be felt. The symptoms, however, may gradually merge into those of strangulation, and it is often difficult to distinguish mere obstruction from strangulation, especially when the former is associated with some inflammation of the sac. When in doubt the case should be treated like one of strangulated hernia. *Treatment.*—A purgative enema, rest in the recumbent position, warmth or ice to the part, and restriction of diet should be prescribed. When there is no vomiting, a brisk purge is often successful, but before giving such the

Surgeon should thoroughly assure himself that strangulation does not exist. The application of the taxis is advised by some, and doubtless, in some instances, the intestine may be emptied of its contents by this means. It should be remembered, however, that its use is not unattended with risk.

5. Inflamed hernia. — In this condition the sac and to some extent its contents are inflamed. Inflammation is most common in small irreducible epiploceles, and is generally the result of injury, the pressure of a badly-fitting truss, or of violent exercise. If neglected the hernia is apt to pass into a condition of strangulation.

The *local symptoms* resemble those of a strangulated hernia, but the impulse on cough is not absent, though it may be less marked than in a hernia in its ordinary state, and there is not so much tension in the sac as when strangulation exists. The parts are hot, tender, and œdematous, and there may be feverish symptoms, vomiting, and constipation. The vomit consists, however, only of the contents of the stomach and is not fæcal, the constipation is seldom complete, and flatus will usually pass.

Treatment.—An icebag should be applied over the hernia, and the patient placed in the recumbent position, with the parts as much as possible relaxed. The diet should be restricted to small quantities of milk and beef-tea, and opium administered in small doses. When all signs of inflammation have subsided an enema may be given if the bowels do not act spontaneously. Should the inflammation run into strangulation, herniotomy must be performed; whilst, should suppuration, a very rare event, occur, the pus must be let out by a free incision.

Fæcal fistula and artificial anus after operation for strangulated hernia.—Fæcal fistula is due to ulceration of the mucous membrane at the seat of stricture, and subsequent perforation of the bowel; artificial anus to the gangrene of a considerable portion of the strangulated bowel. In both, adhesions form between the serous coat of the intestine and the parietal peritoneum, and in this way prevent the extravasation of fæces into the general peritoneal cavity; but in the fæcal fistula the perforation of the bowel being small, most of the fæcal contents are passed per anum; whereas, in artificial anus, the whole escape externally and the intestine below shrinks and becomes more or less atrophied. In fæcal fistula only a fistulous aperture discharging fæces is present; in artificial anus the openings of the upper and lower portions of the intestine can generally be seen. The upper opening may be known by its larger size, redder colour, and by fæces issuing from it, whilst at times its mucous membrane may be prolapsed.

Treatment.—A fæcal fistula will, as a rule, close spontaneously, and beyond keeping the parts clean, nothing is generally required. In artificial anus the spur-like process or *éperon* formed by the projecting forwards of the posterior wall of the bowel by the coils of intestine which lie in the angle between the upper and lower portions of the intestine, may have first to be destroyed by Dupuytren's enterotome, and the lumen of the bowel being thus restored, the artificial anus may be closed by a plastic operation, or the walls of the bowel united by suture. The Surgeon, however, should not be in too great haste to employ the enterotome, as in the course of time, in consequence of the dragging of the mesentery, the spur-like process may become gradually retracted, and the two portions of intestine, instead of lying parallel, may be drawn to more or less of an angle with each other. In this way the lumen of the tube may become gradually restored, and the fæces again pass down the lower tube. A plastic operation will then only be required to close the external opening, if indeed this does not heal spontaneously as in fæcal fistula.

Special Herniæ.

The three most common forms of hernia are:—the inguinal, the femoral, and the umbilical. Of the rarer forms, may be mentioned the obturator, the ventral, the epigastric, the diaphragmatic, the lumbar, the ischiatic, the perinæal, the vaginal, and the rectal.

INGUINAL HERNIA is one which escapes into or through the inguinal canal. Of this form there are two chief varieties, the oblique or external, and the direct or internal.

THE OBLIQUE OR EXTERNAL VARIETY is so called because it descends *obliquely* through the inguinal canal, and leaves the abdomen *external* to the deep epigastric artery. The hernia enters the canal by the internal abdominal ring, and may remain in the canal, when it is spoken of as *incomplete*, or, from its resemblance to a bubo, a *bubonocele;* or it may pass through the canal and out of the external abdominal ring, when it is said to be *complete*, and is then termed a *scrotal* or *labial* rupture, according as it descends into the scrotum or labium. The *coverings* of an oblique inguinal hernia differ according as it is complete or incomplete, and occurs in the male or in the female. When *complete and in the male* they are from without inwards, 1, skin; 2, superficial and deep fascia; 3, intercolumnar fascia; 4, cremasteric fascia; 5, infundibuliform fascia; 6, subperitoneal fat; and 7, peritoneum, which constitutes the sac. In the *female* the cremasteric fascia is wanting; otherwise the coverings are the same. In the *incomplete* the only difference in the coverings is that in place of the intercolumnar fascia there is the aponeurosis of the external oblique, and in place of the cremasteric fascia the lowermost fibres of the internal oblique and transversalis; they are the same in the male and female. The *stricture*, when the hernia is strangulated, will be situated at the external abdominal ring, the internal abdominal ring, or anywhere in the inguinal canal between the two rings.

Varieties of oblique inguinal hernia.—These will perhaps be better understood by reference to the accompanying diagrams. The following are those most commonly described:—

1. The *common* or *acquired form* (*the inguino-scrotal of Birkett*). The sac here consists simply of a protrusion of peritoneum through the inguinal canal, and the hernia when complete may descend into the scrotum or labium. The testicle can always be felt either below, or below and behind the hernia (Fig. 233).

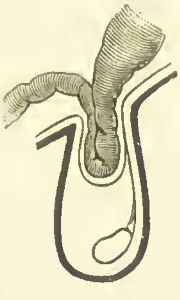


Fig. 233.—Ordinary acquired inguinal hernia. (Bryant's Surgery.)

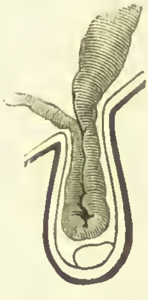


Fig. 234. — Congenital inguinal hernia. (Bryant's Surgery.)

2. The *congenital*. In this form the hernia descends into the funicular process of the peritoneum, which has remained open, and comes into contact with the testicle, the funicular process and tunica vaginalis of course forming the sac. The testis is more or less surrounded

by the hernia, instead of being felt distinctly behind and below it, as in the former variety (Figs. 234 and 235).

3. The *hernia into the funicular process* resembles the congenital, in that the hernia descends into the funicular process of the tunica vaginalis, but differs in that it does not reach the testicle, being cut off from it by a septum at the epididymis. Should an operation be required in this form, the testicle is not seen as in the congenital.

4. The *encysted congenital* (Fig. 236). In this form the funicular process of the tunica vaginalis is cut off from the peritoneal cavity by a septum at the internal ring. The septum yields to the pressure of the hernia, and becomes invaginated before it into the unobliterated funicular process. Should an operation be necessary, the anterior layer of the funicular process, and the elongated septum forming the spurious sac, will have to be cut through. Here, as in the funicular variety, the hernia is not in contact with the testicle.

5. The *infantile hernia* is one in which the intestine, enclosed in its sac, descends behind the funicular process of the tunica vaginalis, which has remained unobliterated but is cut off by a septum at the internal abdominal ring from the general peritoneal cavity. Should an operation become necessary, three layers of peritoneum have to be cut through, viz., the anterior layer of the unobliterated funicular process of the tunica vaginalis; the posterior layer of the same; and finally the true sac. The last two, however, are generally intimately blended,

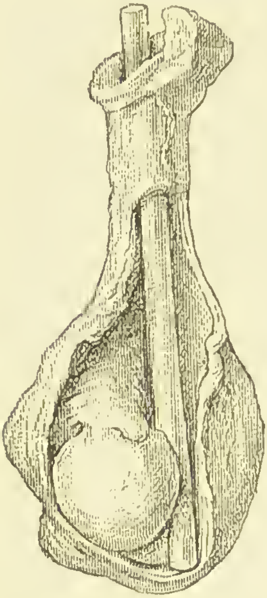


Fig. 235.—A congenital inguinal hernia. The roll of paper is that originally placed in the specimen by Percivall Pott. (St. Bartholomew's Hospital Museum.)

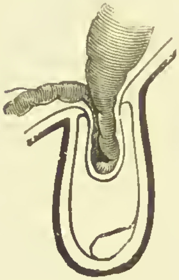


Fig. 236. — Encysted congenital hernia. (Bryant's Surgery.)

so that there are apparently only two layers to be cut through.

THE DIRECT OR INTERNAL INGUINAL hernia is so called because it escapes *directly* through the external abdominal ring without traversing the internal ring and the whole length of the canal, and is situated *internal* to the deep epigastric artery. Before escaping at the external abdominal ring it either passes through or under the conjoined tendon of the internal oblique and transversalis, which is situated immediately behind the external abdominal ring; or it protrudes that structure in front of it. The *coverings* from without inwards are, 1, skin; 2, superficial and deep fascia; 3, intercolumnar fascia; 4, transversalis fascia; 5, subperitoneal fat; and 6, peritoneum forming the sac. When the conjoined tendon is protruded in front of the hernia, this of course constitutes an additional covering, and will then be found between the intercolumnar and transversalis fasciæ. It will thus be seen that the coverings of the direct hernia differ from those of the oblique, in the absence in the former of the cremasteric fascia, and in the substitution of the transversalis for the infundibuliform fascia. The spermatic cord with its coverings from the cremasteric and infundibuliform fascia lies to the *outer* side. From what has been said above it will be seen that the epigastric artery is situated on the inner side of the neck of the sac in the oblique;

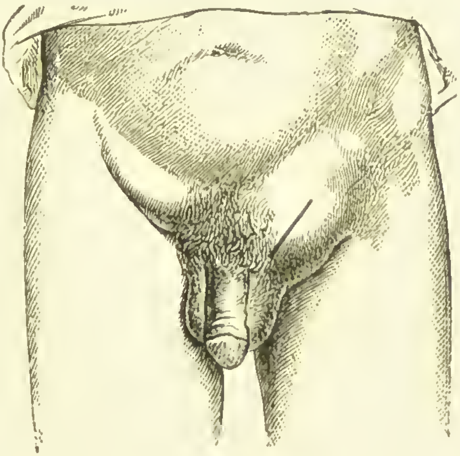


FIG. 237.—Oblique inguinal hernia, with line of incision.

on the outer side in the direct. The *stricture* when the hernia is strangulated will be situated at the external abdominal ring or at the aperture in the conjoined tendon through which the hernia has passed.

Two *varieties* of direct inguinal hernia are described according as the protrusion takes place internal or external to the obliterated hypogastric artery, but are not of sufficient importance to be described here.

Signs and diagnosis of inguinal hernia.—There is a swelling in the inguinal region having the general characters of hernia already given. When *incomplete* the swelling will be in the groin, and has to be chiefly distinguished from a femoral hernia, enlarged inguinal glands, encysted hydrocele of the cord, non-descended testicle, abscess in the inguinal canal, and, in rare instances, from fatty and other tumours of the cord. When it is *complete*, *i.e.*, has passed into the scrotum, the diagnosis has to be made from hydrocele of the tunica vaginalis, solid tumours of the testicle, and varicocele. 1. In *enlarged glands* the canal is free, the glands are felt in front of it, and some cause is present to account for their enlargement. 2. In *femoral hernia* the swelling is external to the spine of the pubes, the neck of the hernia is below Poupart's ligament, the inguinal canal is free but the hernia can be felt through its front wall, and to return it pressure must be made in a direction downwards,

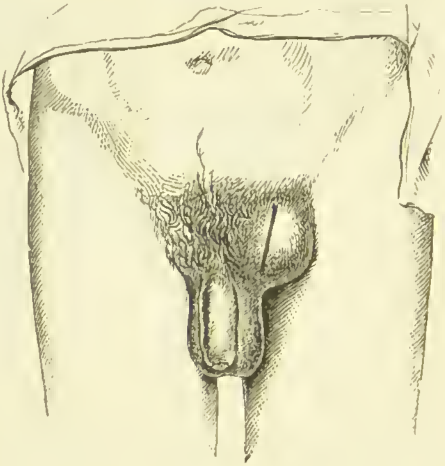


FIG. 228.—Direct inguinal hernia, with line of incision.

backwards, and then upwards. In inguinal hernia, on the contrary, the swelling is internal to, or covers the spine of the pubes; the neck is above Poupart's ligament; the inguinal canal is occupied by it; and to return it pressure must be made upwards and outwards. 3. In *encysted hydrocele of the cord* the swelling is translucent, tense, oval, and well-defined. There is no impulse on cough; and it cannot be returned into the abdomen. 4. In *retained testicle* that organ is absent from the scrotum; there is no impulse on cough; testicular sensation can be obtained by pressure on the swelling; and it cannot be returned into the abdomen. If the testicle is inflamed, vomiting may be present, but it has not the gushing character of the vomiting of hernia, and constipation, if also present, is not complete. There may, however, be a strangulated hernia in addition to an inflamed testicle. The diagnosis in such a case is very difficult. If in doubt an exploratory incision should be made over the tumour. 5. In *hydrocele of the tunica vaginalis* the tumour is translucent, tense, and semi-fluctuating; there is absence of impulse on coughing, freedom of the cord, and a history of it having begun at the bottom of the scrotum. In infants, however, a hernia may be translucent, and in a hydrocele of the congenital variety the fluid can be pressed back into the abdomen, but it does not return with the gurgle or slip characteristic of a hernia. 6. In *varicocele* the dilated veins feel like a bag of worms in the scrotum, and the impulse on cough has a thrill-like character. A varicocele, like a hernia, is reduced on the patient lying down, but if the finger is placed firmly over the ring, the veins, on the patient rising, refill notwithstanding the pressure of the finger, whereas a hernia would remain reduced. The *indirect* hernia cannot practically be distinguished from the *direct* as the rings get dragged opposite one another. The indirect is more common in the young, the direct in the old.

Treatment.—What has already been said on this subject with regard to hernia generally, is applicable here, and it need only be added that if an operation is necessary, the incision (Figs. 237 and 238) should be made downwards and inwards, over the long axis of the hernia, beginning just above the external abdominal ring; that the stricture should be divided *directly upwards*, so as to avoid the epigastric artery; and that when combined with retained testicle a truss should be worn if practicable above the testicle. If the truss causes the testicle to become frequently inflamed, the testicle had better be removed.

A FEMORAL HERNIA is one that escapes into the femoral sheath, and nearly always internal to the femoral vessels, though in very exceptional cases it has been found external to them. As a rule, it leaves the abdomen at the femoral ring, and after passing downwards through the femoral canal, emerges at the saphenous opening, and then turning upwards and outwards over the falciform process of the fascia lata, passes, should it further increase in size, over Poupart's ligament on to the aponeurosis of the external oblique muscle of the abdomen. The neck of the sac is situated at the *femoral ring*, and is therefore bounded in front by Poupart's ligament, behind by the bone, internally by the sharp wiry edge of Gimbernat's ligament, and externally by the femoral vein, from which it is only separated by the innermost septum of the femoral sheath. The spermatic cord is close above it; the epigastric artery passes a little external to it; but there is no structure of importance, as a rule, on its inner, and upper and inner side. The obturator artery, however, may be given off from the epigastric or external iliac artery, and encircle this part of the ring in its course to the obturator foramen (Fig. 239). It is then in great danger of being wounded in dividing the stricture. Fortunately, however, although the artery often rises in this abnormal manner, it does not then, as a rule, take the above-mentioned dangerous course, but passes along the outer side of the ring where it is out of danger. The *coverings of a femoral hernia* are—(Fig. 240) 1, skin; 2, superficial fascia; 3, cribriform fascia; 4, anterior layer of the femoral sheath, called the *fascia propria*; 5, septum crurale; 6, subperitoneal fat; and 7, peritoneum forming the sac. The fascia propria is often

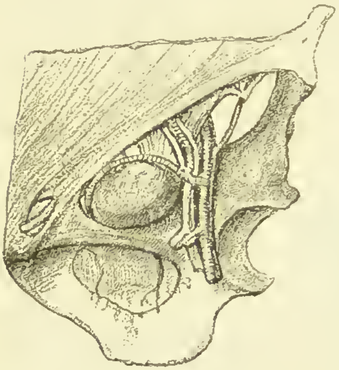


FIG. 239.—The obturator artery given off abnormally from the epigastric, and running round the upper and inner side of a femoral hernia. (St. Bartholomew's Hospital Museum.)

very thin, or in places absorbed, so that little more than skin and one or two delicate layers of fasciæ cover the sac. But it may be greatly thickened, especially over the neck of the sac, where it may form distinct fibrous bands, which go by the name of the *deep crural arch.*

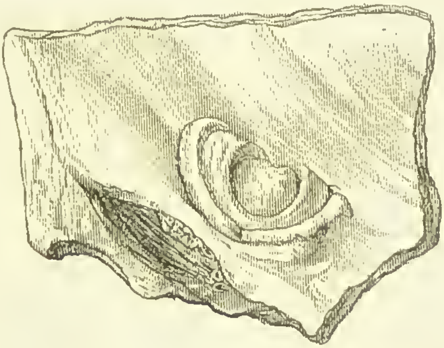


FIG. 240.—Femoral hernia. The coverings dissected off to show the sac. (St. Bartholomew's Hospital Museum.)

Femoral hernia is never congenital; and seldom occurs before adult life. It is more common in women than in men. The *stricture* when the hernia is strangulated is at the saphenous opening, at Gimbernat's ligament, or more rarely at the deep crural arch.

Signs and diagnosis (Fig. 241).—A femoral hernia usually appears as a tense globular swelling at the upper and inner part of the thigh, just below Poupart's ligament internal to the femoral vessels, and external to the spine of the pubes. It is usually small, but may sometimes be as large as an orange, or even larger. It then extends upwards and outwards over Poupart's ligament towards the iliac spine, and appears as an elongated soft and yielding swelling with its long axis parallel to the ligament. Its neck, however, can always be traced below the ligament towards the femoral ring. The characteristic signs of hernia are, of course, present.

The *diagnosis* has chiefly to be made from enlarged glands, varix of the saphenous vein, inguinal hernia, and psoas abscess. 1. In *enlarged glands* there is no impulse on cough; they can be raised from the deeper tissues, and there will probably be some evident cause, as a sore on the heel, &c., to account for them. A small piece of irreducible omentum, however, may almost exactly resemble an enlarged gland in the femoral canal; and it may be impossible to make a diagnosis without exploring the ring, an operation which should always be undertaken if symptoms of strangulation of the intestine are present. At times, there may be an enlarged gland over a hernia. 2. In *varix of the saphenous vein* the vein is generally also varicose lower down the limb, and the impulse on coughing has a peculiar thrill-like character, and extends also some distance down the vein. When the swelling is reduced by placing the patient on her back, and the ring is closed by the finger, the vein refills when she rises, whereas the hernia remains reduced as long as the finger is kept in position. 3. In *inguinal hernia* the neck of the sac is above Poupart's ligament, and inside or over the spine of the pubes; in femoral hernia the neck is below Poupart's ligament and outside the spine of the pubes. In inguinal, the hernia goes back in a direction upwards, outwards and backwards; in femoral, downwards, backwards and upwards. In inguinal, the hernia occupies the inguinal canal, and may descend into the scrotum or labium; in femoral, the inguinal canal is felt free on passing the finger into it. 4. In *psoas abscess* the swelling is generally at first external to the femoral vessels. There is usually fulness in the iliac fossa, and fluctuation can be detected above and below Poupart's ligament. Some cause for the abscess, such as caries of the spine, is generally evident.

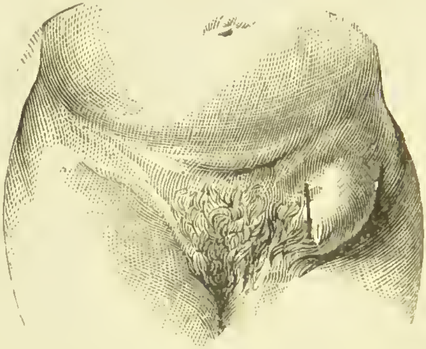


FIG. 241.—Femoral hernia, with line of incision.

Treatment.—All that need be mentioned in addition to what has already been said of the treatment of hernia generally is—1. That the femoral truss (Fig. 228), should have the pad more vertically placed, and the button for the strap should be on the end of the spring and not on the back of the pad, as if placed in the latter situation it causes the pad to rise up and so allows the hernia to escape beneath it. 2. That there is less chance of a radical cure than in inguinal hernia, as the ring on account of its unyielding nature cannot be drawn together by suture. 3. That in applying the taxis the leg should be flexed, slightly adducted, and rotated inwards, to relax the falciform process of the fascia lata. 4. That on account of the unyielding nature of the parts there is but little prospect of reducing the hernia under chloroform or by a hot bath. 5. That should the hernia become strangulated, ulceration is rapidly produced, owing to the pressure of the wiry edge of Gimbernat's ligament. Therefore, if the hernia is not returnable by moderate taxis, an operation should immediately be performed. 6. That the incision (Fig. 241) should be made in a vertical direction over the inner side of the neck of the hernia, the skin being nipped up and transfixed to avoid injuring the sac, as the coverings are often very thin. 7. That the stricture should be divided in an upward and inward direction through the junction of Gimbernat's with Hey's ligament. If made directly inwards the resulting aperture is so large that it is difficult subsequently to keep up the hernia with a truss; while if made directly upwards, the spermatic cord and epigastric artery, and if outwards, the femoral vein are endangered. 7. Several small notches are preferable to a single and larger incision, as there is less danger of wounding an abnormal artery should one be present.

Umbilical hernia (exomphalos, or omphalocele) is one that escapes at the umbilicus. The sac, according to Mr. Birkett, is always an acquired one, and consists of the parietal layer of peritoneum, and never of a natural process of peritoneum like that of the funicular process in the inguinal region. In infancy the hernia passes through the yet unclosed umbilical ring; in adults, through an aperture in the fibres of the linea alba near the umbilicus. It is most often met with in infants; is rare in young adults; and is more common, again, in the old, especially in stout females. The sac is usually very thin, and frequently cribriform or altogether deficient in places: whilst the contents usually consist of omentum and of a small knuckle of intestine which mostly lies concealed in omentum at the neck of the sac. The coverings are—1, the skin; 2, the superficial and deep fascia with a thin layer of fat between them; 3, the fascia transversalis; and 4, the peritoneum, which constitutes the sac. They frequently, however, become so thinned, adherent to one another, or partially absorbed, that the contents of the hernia are merely covered with skin and a thin layer of fascia (Fig. 242).

Symptoms.—In infancy, the hernia, which is known by nurses as "starting of the navel," consists of a protrusion at the umbilicus, readily returning when gentle pressure is applied, and when once seen can hardly be mistaken for any other affection. It generally undergoes a spontaneous cure. In adults it forms a globular, lobulated, or sometimes pyriform swelling, on the lower part of which the cicatrix of the naval is seen. It often attains a large size, nearly always extending as it enlarges downwards towards the pubes, and is frequently in part or completely reducible. It is very liable to become obstructed and less often strangulated.

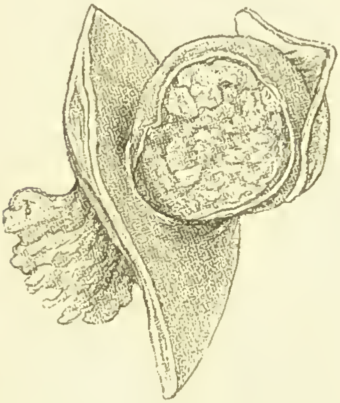


Fig. 242.—Umbilical hernia, showing the attenuated condition of its covering. (St. Bartholomew's Hospital Museum.)

Treatment.—In infants the hernia generally undergoes a spontaneous cure, but a pad, consisting of a piece of cork between two layers of lint, may be applied over it, and fixed with strapping or an india-rubber bandage. In adults, an umbilical truss or bandage is necessary, or when the hernia is irreducible, a hollow supporting truss. When the hernia is incarcerated, the patient must be placed at rest and an enema administered. When strangulated, an operation must be performed. The incision should then be made vertically over the swelling in the middle line, and the stricture divided in an upward direction. If the hernia cannot then be reduced, the sac must be opened, in doing which great care is necessary, as the coverings are often very thin. If the omentum presents first, as is usually the case, search must be made for the intestine, and the latter returned; the omentum must then be unravelled, transfixed with a double ligature, tied, cut off, and the stump also returned. The sac should then be cut off and the ring refreshed and sewn up with deep sutures. Radical cure is occasionally called for when a truss fails to keep up the hernia and strangulation is frequently occurring.

AN OBTURATOR HERNIA is one that escapes through the obturator canal, *i.e.*, the aperture left in the obturator membrane for the passage of the obturator nerve and vessels. The neck of the sac is bounded by the horizontal ramus of the pubes above, and by the sharp edge of the obturator membrane elsewhere; whilst the fundus either protrudes the obturator externus in front of it, or passes above that muscle or between its fibres and comes into contact with the pectineus, giving rise to a slight fulness in the upper part of the thigh just below Poupart's ligament, immediately behind and internal to the femoral vessels. The coverings, therefore, are 1, skin; 2, superficial fascia; 3, fascia lata; 4, pectineus; 5, fascia over the obturator externus; 6, obturator externus (sometimes); 7, pelvic fascia; 8, subperitoneal fat; and, 9, peritoneum, forming the sac, which is always an acquired one. The relation of the obturator artery and nerve to the sac is variable. The hernia is always small, and generally consists of the lower portion of the ileum, often of only a portion of the calibre of the gut. Obturator hernia is rare; it is most often met with after the age of fifty, and then generally in women. It has not always been diagnosed during life, and is often accompanied by other herniæ.

Symptoms.—The chief of these, in addition to those of strangulation which has generally been present, are a slight fulness below and internal to the femoral vessels, perhaps not perceptible unless the two sides are compared; pain down the inner side of the thigh from pressure on the obturator nerve; pain on pressing over the obturator foramen, and perhaps some increased resistance or swelling in this region; pain on rotating the thigh outwards from the obturator muscles, which are then put on the stretch, pressing on the hernia; and pain and swelling in the region of the obturator membrane on examination by the rectum or vagina. From *femoral hernia* it may be known by the neck being below instead of above the ramus of the pubes; and by the femoral ring being free.

Treatment.—The hernia has occasionally been reduced by the taxis, aided in one instance by the hand in the vagina. But this method is dangerous inasmuch as the gut may be injured or may be in a state unfit to return into the abdomen. It is better therefore to make an incision similar to that for femoral hernia, but slightly longer, and having divided the various coverings and opened the sac, to incise the stricture in a direction downwards and inwards, avoiding if possible the obturator artery and nerve. Where the diagnosis is doubtful the ring should be explored either in the way described above or through an incision in the middle line of the abdomen, the hernia, if one is found, being in the latter case drawn out from the ring from within the abdomen, after cautiously dividing the stricture.

DIAPHRAGMATIC, OR PHRENIC HERNIA, is one that protrudes through the diaphragm into the thoracic cavity. It is very rare. The aperture may be due to a congenital defect, to the enlargement of one of the natural openings, or to a wound or laceration of the diaphragm. The hernia usually occurs on the left side, the liver tending to prevent any protrusion on the right. There is no peritoneal sac, the viscus, which is usually the stomach or transverse colon, escaping into the pleural cavity. In the Museum of St. Bartholomew's there is a unique specimen of a hernia of the omentum into the pericardium, the result of a wound.

Symptoms.—In some cases there have been no symptoms; in other cases unnatural fulness and abnormal resonance of the left side of the chest with gurgling on auscultation, excessive thirst, and signs of internal strangulation have been observed. When the result of a wound, pleurisy or peritonitis, or both, have generally soon supervened and carried off the patient. No treatment as far as I know has hitherto been attempted.

The RARER forms of hernia, viz., the *ischiatic*, which leaves the pelvis through the greater ischiatic notch either above or below the pyriformis; the *lumbar*, which escapes between the quadratus lumborum and external oblique; the *perinæal*, which presents between the vagina and the rectum; the *pudendal*, which escapes between the vagina and the ascending ramus of the ischium; the *rectal* and *vaginal*, which protrude respectively into these cavities; and the *ventral*, which escapes through the linea alba, are, on account of space, only mentioned to be dismissed.

DISEASES OF THE RECTUM.

CONGENITAL MALFORMATIONS.—Imperforate anus is the only malformation that needs consideration here. *Cause.* —The intestinal canal in early fœtal life ends at some little distance from the surface of the skin in a blind pouch or cloaca, which is common to it and the genito-urinary organs. In the course of development the cutaneous tissues (epiblast) become invaginated towards the cloaca at the spot which is to be the future anus. The intervening tissues are then gradually absorbed, and a communication is thus established between the cloaca and the surface of the body, the intestinal portion of the cloaca at the same time becoming differentiated from the genito-urinary. An arrest in the above process of development is the cause of imperforate anus. Thus:— 1. Should no invagination of the skin occur, the anus will be entirely absent. In such a case the intestine may terminate in a blind pouch at a variable distance from the surface, a thin membrane or a considerable thickness of tissue intervening between the skin-surface and the interior of the gut. At times the intestine may stop short of the pelvis, the rectum being then of course wholly absent. 2. Should invagination occur, but the intervening tissues not be absorbed, an anus, to all external appearances natural, will be present but will be found to terminate in a *cul-de-sac* a short distance from the surface. Here again either a thin membrane, or a considerable thickness of tissue, may intervene between the top of the *cul-de-sac* and the interior of the gut. 3. Should the process by which the intestinal canal is normally cut off from the genito-urinary portion of the cloaca, also fail, the intestine, instead of ending in a blind pouch, may communicate with the bladder, prostatic urethra, or vagina. In rare cases the intestine may open in some other abnormal situation, as the perinæum or groin.

Treatment.—Where only a thin membrane intervenes its division is all that is necessary; but where there is no appearance of an anus, or evidently a considerable thickness of tissues between the gut and the surface, a vertical incision should be made in the middle line at the spot where the anus should be normally situated. If the distended bowel is now seen or felt to bulge in the wound it should be exposed with a few touches of the knife, and then cautiously opened by an incision made in the same direction as the wound. Should it not be thus discovered, the dissection must be carried on cautiously in an upward and backward direction for an inch to an inch and a half, of course keeping to the middle line and well towards the sacrum lest the peritoneum be wounded. If the bowel is detected it should be opened; no attempt, however, should be made to bring it down, but a bougie passed daily to prevent the wound re-contracting. If not found in this way the colon may be opened in the left loin (*lumbar colotomy*) or in the left groin (*inguinal colotomy*). Opinions differ as to which of these operations is preferable. There are advantages and disadvantages attending each which cannot be here discussed. On the whole the operation in the groin in my opinion is the best. Mayo Robson, however, has recently proposed to continue the dissection in the perinæum, open the peritoneum, seek the end of the gut, pull it down, and fix it to the skin.

PRURITUS ANI, or itching about the anus, though often dependent upon constipation, ascarides, pediculi, eczema marginatum, condylomata, piles or other diseases of the rectum, sometimes occurs without any very evident cause, and has then been attributed to disordered digestion and gouty habit. *Symptoms.*—The itching is often intolerable and is usually worse soon after the patient gets warm in bed. There may be some slight cracks, a little eczema from the scratching, or a moist and reddened condition of the skin, but occasionally there is nothing to be seen. *Treatment.*—The cause if possible should be removed. Where none is very evident the general health must be attended to, the parts kept scrupulously clean, and an ointment or lotion of perchloride of mercury, boracic acid, nitrate of silver, cocaine, &c., applied. I have found lactate of lead, made by pouring lead lotion into milk, to have a very beneficial effect.

FISSURE OF THE RECTUM is a small painful crack or ulcer usually situated just within the anus, and seldom involving more than the skin or mucous membrane. *Causes.*—Almost always constipation; sometimes neglect of local cleanliness, or other source of irritation. The passage of an unusually hard motion is often the immediate exciting cause. When the ulcer is once thoroughly established, healing is prevented by the action of the sphincter and the irritation of its surface during the passage of a motion. *Symptoms.*—The chief of these is pain, the result of spasm of the sphincter. It is often very severe, and occurs during and after defæcation. It may last for a few minutes or longer, even to several hours, and then ceases till the next motion. The pain may not only be felt in the anus, but may be reflected down the thighs or to other parts, as the uterus, vagina, or testicle. The motions are often slightly streaked with blood, sometimes with pus. On examination the sphincters are found spasmodically contracted. On gently everting the margins of the anus the end of the ulcer will be discovered usually at the posterior part, a small external pile or an œdematous fold of skin which is generally present then serving as a guide to it. The passage of the finger is attended with great pain. *Treatment.*—In slight cases the use of laxatives and the application of astringent lotions or ointments may be sufficient. If these fail the sphincter must be forcibly dilated, or the ulcer divided together with half or more of the external sphincter by drawing a straight bistoury longitudinally through the base of the ulcer. The bowels should then be kept confined for four or five days, and the motions afterwards kept soft for a fortnight or longer. Or the sphincter may be divided subcutaneously by passing a tenotomy knife beneath it through the mucous membrane and cutting outwards towards the skin. This little operation may be done without pain by painting the mucous membrane at the seat of puncture with cocaine, and does not necessitate the patient's lying up for more than two or three days.

PROLAPSUS RECTI is the protrusion of the mucous membrane of the lower part of the rectum, and more rarely of the muscular coat as well, through the anus. It is most common in children, but may occur at any age. The *causes* are either a relaxed state of the sphincter induced by general weakness, residence in hot climates, &c., or excessive straining due to stricture of the urethra, phimosis, stone, ascarides, constipation, piles, or polypus. *Signs and diagnosis.*—It commonly appears as an irregular ring of mucous membrane, or when much is protruded, as a cylindrical elongated swelling. When recent, it has the colour of healthy mucous membrane, but if not soon reduced it may become livid and congested, in consequence of constriction of the blood-vessels by the sphincter. The strangulation may proceed to such an extent that the prolapsed portion may undergo mortification and slough away. In old-standing cases it becomes indurated and leathery from exposure. It may be diagnosed from polypus by the presence of a central aperture, and from intussusception by the mucous membrane being continuous with that of the sphincter. In intussusception a sulcus exists between the protruded part of the bowel and the sphincter.

Treatment.—Should the bowel be protruded or strangulated, an attempt should be made to reduce it. If it has only been prolapsed a short time, this is easily accomplished by gentle pressure, the parts having been well smeared with vaseline and the buttocks raised. When of longer standing, firm pressure must be exercised on it for ten minutes or so, or the finger may be introduced into the orifice and the bowel pressed back. If reduction fails and the part is much inflamed, an ice-bag may be applied, and another attempt subsequently made, when, if still unsuccessful, nothing remains but to allow the protruded part to slough off or to excise it. If the muscular coat protrudes, no operation should be done lest the peritoneum be wounded. Having reduced the bowel, the cause of the prolapse should, if possible, be removed, and to prevent a recurrence the nates may be strapped together, or a pad and T-bandage worn, and the motions passed at bed-time instead of in the morning, the patient lying on his side or back during defæcation. Astringent lotions or ointments of sulphate of iron, galls, or tannin should be applied, or the mucous membrane painted with nitrate of silver, whilst any pendulous folds of skin may be snipped off, so as to cause some amount of contraction of the anus. In the meanwhile, the motions should be rendered soft with gentle laxatives. Should these means, after being well persevered in, fail, a more serious operation may become necessary. Thus, portions of the mucous membrane may be removed by ligature; or the galvano-cautery may be applied in two or three situations, so as to produce lines of burns in the long axis of the bowel, and thus cause the mucous membrane to adhere to the muscular coat by inflammation.

HÆMORRHOIDS OR PILES, are swellings inside or around the margin of the anus, the result of a dilatation or varicose state of the blood-vessels.

Causes.—The peculiar anatomical arrangement of the hæmorrhoidal veins; the absence of valves in them and in the veins through which they communicate with the portal vein, whereby they have to sustain the whole weight of the column of portal blood; and their situation between the muscular and mucous coats of the rectum, so that they receive but little support during defæcation, render them exceedingly liable to become dilated or varicose. Anything, therefore, that tends to congest the portal system, and hence obstruct the return of venous blood from the hæmorrhoidal veins, such as high living, habitual constipation, cirrhosis of the liver, heart-disease, &c., may be looked upon as predisposing causes; whilst anything determining local congestion of the part, such as straining at stool or to pass water in cases of enlarged prostate or stricture of the urethra; the pressure of the gravid uterus, distended colon, or ovarian or other pelvic tumour; stricture of the rectum; and the abuse of aloetic purgatives, may be regarded as exciting causes.

Pathology.—Hæmorrhoids consist at first of little more than dilated veins, but after they have existed some time the blood in their interior may clot, the vein-walls hypertrophy, and the connective tissue of the dilated vein become infiltrated and thickened. If a pile is now cut into, it presents a spongy vascular structure, and there is often a small artery in its centre. Piles may be situated external to the sphincter, and are then covered with skin (*external or blind piles*); or within the sphincter, when they are covered with mucous membrane (*internal or bleeding piles*). In many instances, however, they may be covered in part with skin, and in part with mucous membrane (*mixed piles*). An œdematous and swollen condition of the muco-cutaneous folds and hypertrophied flaps of skin about the margin of the anus, although not produced by dilatation of the veins, is also generally spoken of as piles. *External piles* occur as soft, globular, pinkish-blue swellings, or as moderately firm fleshy tumours, or as little more than loose hypertrophied folds of skin. *Internal piles* also present various forms. They may consist of small hæmorrhoidal veins, dilated and varicose, giving the mucous membrane a dark purplish colour, and rendering it liable to become prolapsed during defæcation; or they may form either slightly raised, flattish and oblong elevations, or distinctly globular pedunculated swellings (Fig. 243). They may appear very vascular from the congestion of the mucous membrane covering them, and then constitute the bleeding pile; or they may be firm and fleshy and of a reddish brown colour from the thickening of the mucous membrane, and then do not readily bleed. The hæmorrhage is usually arterial, and comes from the small arteries in the mucous membrane.

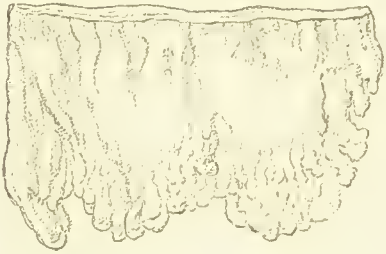


Fig. 243.—Internal Piles. (St. Bartholomew's Hospital Museum.)

Piles, whether external or internal, are at times liable to become inflamed and slough.

Symptoms.—External piles, beyond causing some amount of itching and unpleasant sensation about the rectum, may give rise to no symptoms unless irritated or inflamed. They are then often a source of much distress. The pile becomes swollen and painful, the pain being reflected to the surrounding parts and increased on sitting, standing, and walking. The acute symptoms usually subside in a few days, but often leave the parts thickened and irritable, and are liable to recur from time to time. *Internal piles* are productive of more trouble, the chief symptoms to which they give rise being hæmorrhage, and irritation and pain consequent on their protrusion and constriction by the sphincter, or as the result of their becoming inflamed; whilst the hæmorrhage, when severe, may be productive of anæmia and all its attendant constitutional symptoms. The amount of hæmorrhage, which is sometimes of an arterial character, may vary from a few drops—a mere streaking of the motions with blood—to several ounces.

When first noticed, the protrusion of the piles occurs only during defæcation; and although they may at first go back spontaneously, they often require replacement by the finger, as otherwise they are apt to become strangulated by the sphincter and irritated or inflamed from the chafing of the clothes. Later the sphincter becomes dilated, and they may protrude at times other than during defæcation, and in long-standing cases the mucous membrane becomes permanently prolapsed, and the pile remains constantly protruded. External piles then generally form in addition to the internal, whilst the mucus exuded from the parts is a constant source of annoyance. The constitutional symptoms to which the loss of blood and pain and irritation may give rise are pallor, palpitation, breathlessness, fainting and headache; and from the reflex character of the pain the patient may refer the symptoms to other organs, as the testicle, bladder, kidneys, or uterus.

Diagnosis.—*External piles* may be readily diagnosed from condylomata, polypi, and epithelioma by the characters already given. *Internal piles* may be suspected from the above mentioned symptoms, and if not protruded they may generally be brought into view by asking the patient to bear down as if to defæcate, whilst the surgeon makes gentle traction on the margin of the anus. If this does not succeed and the bowel is loaded an enema should first be given. Examination with the finger, unless the surgeon has had great experience, fails to detect the pile, as when neither irritated, inflamed, nor protruded, it is soft and flaccid, like the rest of the mucous membrane.

The treatment of piles may be divided into the palliative and the radical.

The *palliative* treatment consists in employing such means as are calculated to relieve the congestion of the hæmorrhoidal veins. Thus constipation must be combated by the use of such laxatives as the confection of senna, compound liquorice powder, the liquid extract or cordial of cascara sagrada, or Pullna or Friedrichshall water; whilst strong purgatives, especially aloes, high living and alcoholic stimulants, should be avoided and the secretions of the liver promoted by exercise. Where there is hæmorrhage, the tincture of hamamelis or of steel will be found very useful. Locally, the parts should be kept scrupulously clean, and astringed by such applications as the liquid extract of hamamelis, the compound ointment of galls, or lotions of sulphate of iron, acetate of lead, or tannic acid, passed through the sphincter; or by injections of iced cold water, to which tincture of hamamelis may be added. When the piles are inflamed, the patient should rest in bed with the buttocks raised, and an ice-bag or hot poultice be applied, and a morphia suppository introduced into the rectum. Where coagulation has taken place free incision into the pile and turning out the clots will give relief.

The *radical* treatment consists in removing the piles, but should only be resorted to when palliative measures after a fair trial have failed, or unless the piles are more or less constantly down. It need hardly be said that no operation should be performed when they are merely symptomatic of some more serious disease, as stricture or cancer of the rectum, enlargement of the prostate, or disease of the uterus, bladder, or liver, or are the result of pregnancy. The method of removing the piles differs according as they are external or internal.

External piles may be simply snipped off with the scissors, care being taken, however, not to remove too much of the integument lest troublesome contraction of the anal orifice should ensue.

Internal piles may be treated by ligature, the clamp and cautery, crushing, injections with carbolic acid, excision, or the application of nitric acid. Whatever method is employed a purgative should be given the day before, and the rectum cleared on the morning of the operation by an enema; and after the patient is under the influence of the anæsthetic, the anus should be forcibly dilated to bring the parts well into view.

If the *ligature* is employed, the most prominent pile should be seized with the pile-forceps or pile-hook, and the mucous membrane incised with the pile-scissors at its junction with the skin, so as to detach the pile and mucous membrane from the anal margin. A carbolized silk ligature should then be placed in the groove thus formed and tied tightly around the undetached base of the pile, taking care to include as much of the mucous membrane above the pile as possible. The greater part of the pile having been excised, the ends of the ligature are cut off and the stump of the pile returned after the others have been treated in a similar way. The parts should be thoroughly dusted with iodoform, a morphia suppository passed through the anus, and a large pad of iodoform wool applied and secured *in situ* by a T-bandage. The bowels should be kept confined for four or five days by small doses of opium combined with tincture of catechu, and then opened by an enema of olive oil. Should retention of urine occur, as is very common after operations on the rectum, it should be relieved by passing a soft catheter.

The ligatures generally come away about the ninth to the eleventh day.

Clamp and cautery.—A pile having been seized with the forceps, the clamp is applied to its base, the pile shaved off, and the raw surface cauterized.

If *crushing* is employed, the pile is drawn into the crusher, which is then screwed tightly home, the pile cut off, and the crusher removed after a minute or two.

Excision has of late been extensively employed by some surgeons. It consists in dissecting away the piles, tying any arteries that bleed, and bringing down the mucous membrane and securing it by suture to the anal margin.

Injections of carbolic acid.—The strength usually employed is half a drachm of the acid, to a drachm each of glycerine and water, four or five minims being thrown into the centre of the pile by a hypodermic syringe. The process has to be repeated several times, and takes some weeks to effect a cure.

Nitric acid is a useful and efficient application for the sessile vascular pile, and should be applied with a glass rod through a speculum and any excess of acid removed by a weak alkaline lotion.

An ISCHIO-RECTAL ABSCESS (Fig. 244), is one that forms in the loose cellular tissue in the ischio-rectal fossa, and should be distinguished on the one hand from the small abscesses which may occur round the margin of the anus in the cutaneous folds (*perianal*); and on the other hand from the abscesses which may form between the mucous and muscular coats of the rectum or around the gut in the pelvic cellular tissue. The *cause* of ischio-rectal abscess is inflammation around the rectum (*periproctitis*). The inflammation may be due to perforation of the mucous membrane by a fish bone or other foreign body, followed by ulceration and the escape of fæces into the ischio-rectal fossa; or may be due to injury from without, as a kick or blow. In tubercular subjects abscess is common from very slight causes, and is probably then the result of the breaking down of a local deposit of tubercle. The *symptoms* vary as the abscess is acute or chronic. The acute begins with pain, which soon becomes throbbing, and is followed by swelling and redness on one side of the anus, and later by fluctuation. In the chronic the symptoms may be so slight as to escape notice till the abscess bursts into the bowel and the pus escapes by the anus. *Treatment.*—An early incision should be made in order to prevent, if possible, the abscess breaking into the bowel and a fistula resulting. The incision should be free and of a T-shape, to secure a free vent for the discharge and promote the healing of the abscess from the bottom, lest the abscess-cavity, as is very frequently the case, from the constant action of the sphincter, degenerate into a fistula (Figs. 245, 246, and 247).

Fistula in ano is a fistulous track by the side of the rectum. Three forms are described:—1. The *complete* (Fig. 245), in which the fistula opens internally into the rectum, and externally on to the skin; 2. The *blind external* (Fig. 247), in which it only opens on to the skin; and 3. The *blind internal* (Fig. 246), in which it only opens into the bowel.

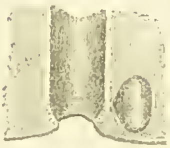


Fig. 244. — Ischio-rectal abscess.

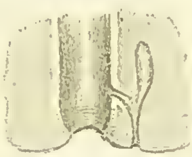


Fig. 245. — Complete fistula.

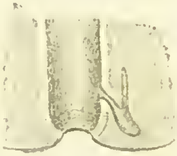


Fig. 246. — Blind internal fistula.

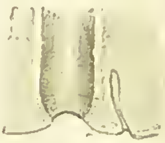


Fig. 247. — Blind external fistula.

The complete (Fig. 245) is by far the most common form. It generally extends obliquely upwards on one side of the rectum and opens into the bowel within an inch above the anus, or it may take a curved course around the bowel and then open into it (the *horse-shoe fistula*). Frequently it extends up beyond the internal opening by the side of the rectum in the form of a *cul-de-sac;* or it may, though very rarely, open into the bowel several inches above the anus. In rare instances there may be two internal openings. Secondary fistulæ branching off from the main fistula are often found burrowing beneath the skin of the perinæum and buttock, and sometimes opening at a considerable distance from the anus. The external opening, however, is usually about half an inch from the anus; but it may be a greater distance from it; or close to it, and then, perhaps, hidden by the loose folds of skin. It may be little more than a minute hole exuding a slight moisture; or it may be encircled by a ring of granulations, and the skin in its neighbourhood may be red and brawny. The fistulous track itself will generally be found lined with a smooth shining membrane, and its walls indurated when it has existed some time.

Causes.—A fistula is generally the result either of the bursting of an ischio-rectal abscess into the bowel, or on to the skin, or in both directions; or of ulceration or perforation of the mucous membrane and the extension of the ulcerative track downwards towards the skin, which it may or may not penetrate. It is often seen in phthisical subjects, and occurs as a complication of cancerous and other strictures of the rectum. The two chief reasons why the fistula does not close are the constant movements of the sphincter and the escape of fæcal matter into it.

Symptoms.—Uneasiness, pain or tenderness of the parts, especially on defæcation and movement; more or less constant discharge of pus or purulent fluid from the external opening; escape of fæces where the fistula is complete, or a discharge of pus from the bowel if the fistula is of the blind internal variety; mental worry, anxiety and depression; at times exacerbation of the inflammation with pain and increased discharge; and probably the history of a previous abscess having formed in the ischio-rectal fossa.

Diagnosis.—In the *complete variety* (Fig. 245) the diagnosis is readily made by passing a probe up the fistula into the bowel, and by feeling the internal opening (which has sometimes the form of a small depression in the centre of a slight papilla-like eminence) with the finger in the rectum. In the *blind internal* (Fig. 246) a soft spot in the centre of an indurated portion of the tissues by the side of the anus will be felt, and probably an indurated track will be detected leading from this towards the bowel. The internal opening, which has the characters given above, will be discovered just within the anus on passing the finger into the rectum. Into this opening a bent probe may be passed, and its end made to project under the soft spot on the skin-surface. In the *blind external* (Fig. 247) the probe cannot be made to enter the bowel on being passed up the fistula, and no internal opening can be felt in the rectum by the finger. In all cases the rectum should be carefully examined to exclude stricture or cancerous disease. From urinary fistulæ tracking down towards the anus a fistula in ano is readily distinguished by the characters given above, and by the absence of urethral and bladder trouble, and by no urine escaping through the fistula.

Treatment.—Although in exceptional instances fistulæ have closed spontaneously, an operation, as a rule, is required. A director should be passed through the fistula into the bowel, and its point hooked down and brought out at the anus by the index finger, which has been passed up the rectum. The bridge of tissue, which sometimes includes the external sphincter, is then divided by running a curved bistoury along the director. A careful search should now be made with a probe for all secondary fistulæ or lateral sinuses and these laid freely open. The lining membrane of the fistula should next be destroyed by scoring it with a bistoury, or scraping it with a Volkmann's spoon, as otherwise the fistula is apt to re-form. The wound should finally be filled with iodoform wool, and a pad and T-bandage applied. The bowels should be kept confined for about four or five days with small doses of opium, and then relieved by castor-oil or an enema. The wound should be dressed daily with iodoform wool lightly pressed into it to insure its healing from the bottom. The blind external and the blind internal should be converted into complete fistulæ by forcing in the former case a director up the fistula into the bowel, and in the latter by cutting through the skin on the point of a bent probe hooked into the internal opening and made to project under the skin. Both are then treated as a complete fistula. When the opening is very high up, a stout ligature may be passed and made to cut its way out, the fistula healing behind it. But as this takes a long time, it is better to reduce the fistula in this way to reasonable limits and then divide it. Before operating for fistula the chest ought always to be examined, since should tubercle in the lungs be discovered no operation should be done, unless the tubercle is in quite an early stage.

Polypi generally occur as pedunculated growths springing from the submucous tissue, usually of the lower part of the rectum. They vary in size from a pea to a cherry, and in colour from white or pale pink to a deep red. Two chief forms are described, the *soft and vascular*, which approach the adenomata and myxomata in structure, and are most common in children; and the *hard or fibrous*, which are more rare and generally occur in adults.

Symptoms.—Polypi are the commonest cause of bleeding from the rectum in children, the blood escaping not only during but also after defæcation. When low down they cause straining, perhaps a mucous discharge, and pain after defæcation from being caught in the sphincter. When large, they may produce prolapse or intussusception. Small polypi beyond the reach of the sphincter may cause no symptoms. They are readily detected by sweeping the finger well round the rectum, the examination being best made after the bowels have been emptied and the polypus brought down by an enema.

The *treatment* consists in ligature of the pedicle, followed by excision of the growth. They do not recur.

VILLOUS TUMOURS of the rectum are rare and are most frequently met with in patients over forty years of age. They have a papillomatous structure, and spring from the mucous membrane. Frequent hæmorrhages and the passage of a glairy mucous discharge are the chief signs. Removal is the treatment. They are apt to recur and then to become malignant.

STRICTURE OF THE RECTUM may be divided into the simple and the malignant.

1. THE SIMPLE OR FIBROUS stricture may be caused by the fibroid contraction of inflammatory products in the mucous and submucous coats, or of cicatrices following simple, syphilitic, or dysenteric ulceration, injury, or operation on the bowel.

Pathology.—The stricture is generally situated from one to two inches from the anus, but may occur at any part. It may involve only a narrow ring-like portion, when it is called annular; or it may include an inch or more of the gut, when it is sometimes spoken of as tubular. The strictured portion of the bowel consists in great part of fibrous tissue. The *syphilitic* variety is often combined with condylomata or ulceration about the anus, and the mucous membrane between the anus and the stricture is frequently ulcerated. The bowel above is generally distended with fæces, the muscular coat hypertrophied, and the mucous membrane ulcerated; whilst, in the neighbourhood of the stricture, the coats are often so thin that the least force causes them to give way. Fistulæ often form below the stricture, and hæmorrhoids are a frequent concomitant.

Symptoms and diagnosis.—Pain and difficulty in passing a motion, constipation, and later, constipation alternating with diarrhœa. The motions become small, pipe or ribbon-like, and streaked with discharge. There is a frequent desire to defæcate, but little passes except wind and discharge, and the bowels feel as if they had not been emptied. In tight strictures or in strictures with ulceration fistulæ may sometimes form about the anus, and the patient gets worn out and after many years perhaps of suffering may die of an attack of peritonitis or obstruction. The stricture is readily detected on passing the finger, but is often so tight that only the tip can be got into it. When this is the case on no account should the finger be passed through it, as the slight force of passing the finger may rupture the attenuated walls and peritonitis and death may follow.

Treatment.—As a rule, gradual dilatation by means of bougies, of which the conical ones of Mr. Cripps or the soft flexible ones of Mr. Goodsall are perhaps the best, should be first attempted, and will generally be successful; but the stricture must be kept dilated by the subsequent occasional passage of a bougie. In exceptional cases, where the stricture is very resistant, a bougie may be tied in. Where the parts are much riddled by fistulæ a division of the stricture may be necessary. This may be done by what is called internal or external *linear proctotomy.* In the former operation the knife, guarded by the finger, is introduced through the stricture, which is then divided in a posterior direction; in the latter, the stricture together with the external sphincter and other intervening soft parts are completely divided down to the coccyx.

2. MALIGNANT OR CANCEROUS STRICTURE.—*Pathology.*—Cancer, in all its forms, may occur in the rectum, but the most common is a variety of epithelioma known as the columnar or adenoid. It occurs either as a fungating, more or less distinct tumour projecting into the lumen of the bowel, or as a laminar, nodular, or ring-like infiltration of its coats. In either case, it is at first covered by apparently unaltered mucous membrane, which, however, is sooner or later destroyed by ulceration, leaving an ulcer with an uneven, proliferating, or excavated surface, everted edges and an indurated base. As the disease extends it involves the muscular coat, and subsequently the surrounding structures and organs, gluing them, as it were, to the rectum, and finally converting the whole into a cancerous mass. The lymphatic

glands in the pelvis, and later the inguinal glands and others more removed, become affected, and the carcinoma may finally be disseminated, secondary growths being more especially met with in the liver. The *symptoms* are often very insidious. At first there may be merely some uneasiness, hardly amounting to pain, about the anus; then more or less pain on defæcation is noticed; the fæces may be streaked with mucus or with blood; and a slimy discharge may be present. Later the motions become small, flattened, pipe-like or scybalous. The patient strains at stool, and feels as if his bowel had not been emptied; then there is constipation alternating with diarrhœa, and an offensive sanious discharge. Emaciation and cachexia now come on, with more local pain, and the patient dies of exhaustion, peritonitis, or during an attack of acute obstruction.

The *diagnosis* can only be arrived at by a local examination. The anus generally appears healthy, though probably patulous, and a healthy strip of mucous membrane generally exists between the anus and the growth. When the growth can be felt, its indurated base, and when ulceration has occurred, the everted edges of the ulcer, and the sanious and foul discharge, render the diagnosis generally easy. When beyond the reach of the finger it may at times be brought down by asking the patient to strain. The fungating form may be mistaken for a villous growth; the annular, for a simple fibrous stricture. A *villous growth* may be distinguished by its velvety and supple feel, by its not ulcerating and breaking down, by the absence of induration, by the discharge being thin and mucoid, the blood bright and small in quantity, and the rectum not fixed, and by the duration of the disease. A *fibrous stricture* may be known by its longer duration, by being less indurated than the cancerous form, by the bowel not being fixed, and when due to syphilis by the absence of a healthy strip of mucous membrane between the growth and the anus.

Treatment.—If the disease is seen sufficiently early and before it has involved the surrounding parts, if it is not situated too high up the rectum, and if the general condition of the patient is otherwise favourable, the excision of the growth with the lower end of the rectum should be undertaken, as in this way the whole may be removed, and not without reasonable hope in some of the less malignant forms of the disease of its not returning. Some cases have been reported where it has not done so for upwards of four years. Where removal seems impracticable, or otherwise unadvisable, such palliative measures should be adopted as may render the last few months or years of the patient's life as comfortable as possible. Thus the bowels should be kept gently relaxed, the diet regulated, and the pain relieved by morphia suppositories. In this way the patient can often follow his occupation in comparative comfort and with little inconvenience. Should, however, there be much pain and irritation on the passage of fæces, or obstruction threaten or have already occurred, colotomy should be performed (p. 619). This operation should not, as is too frequently the case, be regarded merely as a last resource, to be undertaken when obstruction has come on, as then the danger of the operation is greatly increased. Nor should it be undertaken in every instance, since the inconvenience caused by the cancer is not always sufficient to justify the patient undergoing the risk.

Excision of the rectum may be performed if the finger can be passed beyond the growth ; if the growth is moveable; if the glands are not involved, and if the patient is otherwise fairly healthy. The patient having been placed in the lithotomy position and a staff introduced into the bladder, a curved bistoury should be passed along the finger up the rectum, and its point made to emerge near the coccyx, and the intervening tissues cut through in the middle line. By this incision a free exposure is obtained. Lateral incisions are next made on each side of the anus, meeting in front, and the bowel is rapidly cleared either with the finger or with the handle of the scalpel from the tissues of the ischio-rectal fossa. The lower part of the rectum is now dissected more carefully from the urethra and prostate, and having been sufficiently freed, the écraseur is placed above the growth, and the rectum removed, care being taken that the cord when tightened is not pulled down below the spot where it is intended to sever the bowel. If preferred the scissors may be substituted for the écraseur, the vessels being then tied as they are cut. When the growth does not involve the whole of the bowel, a strip of mucous membrane should, if possible, be left. The wound should be plugged for twenty-four hours with iodoform gauze if there is much oozing, and the parts subsequently irrigated frequently.

DISEASES OF THE URINARY ORGANS.

SURGICAL DISEASES OF THE KIDNEYS.

NEPHRITIS, or inflammation of the kidney, as met with in surgical practice, is commonly the result of long-standing disease of the bladder, urethra, or prostate, or of the impaction of a calculus in the ureter or pelvis of the kidney. Traumatic nephritis has already been alluded to under *Injuries of the Abdomen.*

The inflammation when secondary to other diseases of the urinary organs may be produced in several ways. Thus, it may be due to—1. Tension in the tubules of the kidney, resulting from obstruction to the outflow of urine consequent upon long-standing stricture of the urethra or prostatic enlargement. Under these circumstances the inflammation falls chiefly on the cortical and medullary substance of the kidney (*Interstitial nephritis*). 2. The presence of septic matter in the pelvis of the kidney due to (*a*) the spread of inflammation up the ureters from the bladder, or (*b*) decomposition of pent-up urine behind an impacted calculus in the ureter or pelvis of the kidney. In this case the inflammation is of a septic or suppurative character, and although it may chiefly affect either the lining membrane of the pelvis (*pyelitis*) or the substance of the organ (*suppurative nephritis*), it more generally involves both (*pyelo-nephritis*). At times, the pelvis and calices become distended with the pus, and the kidney is finally converted into a suppurating cyst (*pyo-nephrosis*). 3. Reflex irritation of the kidney through the nervous system, as from the passage of a catheter in stricture or enlarged prostate, or the performance of some operation on the urinary organs as lithotomy or lithotrity. Here the inflammation is usually transitory, unless the kidneys are already suffering from the effects of urinary obstruction, when it may run on to suppuration.

Simple interstitial nephritis usually begins in an insidious manner, the *symptoms* of the kidney mischief being obscured by the primary affection of the urinary organs from which the patient is probably suffering. It may be suspected, however, where there is a continual loss of strength, increasing pallor, and gradual wasting. The urine is passed in large quantities, and is of low specific gravity. Albumen at first is absent, or only present in small quantities, and although later it may be increased in amount, it is often difficult to estimate in consequence of the pus, mucus, or blood which may be present, owing to the bladder or other urinary trouble. Should these not be relieved, the symptoms of the affection become more marked; there is loss of appetite, a furred tongue, nausea, perhaps vomiting, increase of temperature at nights, a hot skin, thirst, and emaciation. This condition may last for months, when the symptoms may gradually subside if the primary trouble can be removed; or it may terminate in exhaustion and death; or in an acute attack of suppurative nephritis.

The *treatment* consists essentially in removing the cause where this is practicable, and carefully avoiding all sources of irritation that may re-act through the nervous system on the kidney. Thus, all instrumentation must be done in the gentlest possible manner, and decomposition of the urine prevented by washing out the bladder with antiseptic solutions. The patient at the same time should be kept in bed, and restricted to a non-stimulating and chiefly fluid diet; whilst hot flannels and occasionally dry cups should be applied to the loins.

Suppurative or septic nephritis.—Under this head is included suppuration of the pelvis and of the substance of the kidney, as both, as a rule, are simultaneously affected, and the symptoms are similar or identical. Pyonephrosis is considered separately. Suppurative nephritis generally occurs suddenly in the course of long-standing disease of the lower urinary organs, attended with septic decomposition of the urine in the bladder, and is usually preceded by simple interstitial nephritis.

The *symptoms*, which frequently first come on after some operative procedure, are usually ushered in by a rigor followed by sweating and fever. The tongue becomes dry and red; the lips and teeth covered with sordes; the appetite is lost; nausea, vomiting, or diarrhœa sets in, and the patient usually sinks into a typhoid state and dies. There is no œdema, and the urine usually continues abundant and loaded with pus to the end, though it may at times be diminished in quantity or even suppressed. It may or may not contain blood.

Treatment as a rule is of little avail; but the same general plan should be followed as described under simple interstitial nephritis. Where the cause can be effectually removed recovery may at times take place.

CIRCUMSCRIBED ABSCESS may occur in the kidney substance or in the cellular tissue around (*peri-nephritic abscess*). It must be distinguished from pyonephrosis, in which the pelvis and calices are distended with pus. *Cause.*—It is generally due to injury, pyæmia, or renal calculus. When it occurs in the peri-renal tissue, it may be consecutive to abscess or other disease of the kidney itself; or it may be due to causes independent of the kidney, as cold, disease of the spine, and other conditions leading to the formation of abscesses. The *symptoms* are those of deep suppuration, attended with certain peculiarities on account of its situation, which however cannot be here discussed. The *treatment* consists in making a free incision into the abscess through the loin.

HYDRONEPHROSIS is an over-distension of the pelvis of the kidney with altered urine. *Cause.*—Any condition in the bladder, ureter, or pelvis of the kidney, producing mechanical obstruction to the outflow of urine. These conditions may be divided into the *congenital*, such as twists of the ureter, smallness of its vesical orifice, &c., and into the *acquired*, such as impaction of a calculus in the ureter, enlarged prostate, stricture of the urethra, &c. *Pathology.*—The pelvis, and subsequently the calices of the kidney, become distended with urine, the cortical substance is destroyed by the pressure of the retained urine, and the whole organ finally converted into an irregular cyst. The hydronephritic fluid consists of altered urine, and may contain hardly a trace of urea. *Symptoms.*—When the obstruction is complete, a tumour is found in the abdomen, and often attains a great size. It may then be mistaken for an ovarian cyst, a hydatid cyst of the liver or omentum, a distended gall-bladder, a splenic tumour, a solid tumour of the kidney, or pyonephrosis. From these a hydronephrotic kidney may generally be distinguished by the colon being in front of it, by the presence of fluctuation, by its dulness to percussion, by its situation in the flank, by its projection more or less in the loins, by the uterus being free and not displaced, and by the absence of febrile symptoms. *Treatment.*—Aspiration, unless the tumour is small and painless, when it may be left alone, should first be tried; but if the fluid rapidly re-accumulates, nephrotomy will usually be required.

PYONEPHROSIS is the distension of the pelvis and calices of the kidney with pus, and the subsequent destruction more or less complete of the medullary and cortical substance, the whole kidney being at length converted into a large multilocular cyst. This cyst may rupture into the peritoneal cavity or colon, or into the surrounding tissue, causing a perinephritic abscess. *Causes.*—It may follow pyelitis, owing to the blocking of the ureter with a clot of blood or pus; or it may be engrafted on hydronephrosis consequent upon tapping or injury. At times it may be the result of tubercle, or of a direct injury of the kidney. *Symptoms.*—In addition to a tumour in the abdomen with characters similar to those of hydronephrosis, there will be pain in the tumour, especially on pressure, febrile disturbance, and if the obstruction of the ureter is incomplete, pus in the urine from time to time. *Treatment.*—Having aspirated the tumour, and discovered the presence of pus, nephrotomy is generally indicated, especially if the tumour rapidly refills, and there is much pain or febrile disturbance, or rupture of the cyst appears imminent. If after nephrotomy, however, the cyst does not shrink and cease to suppurate, nephrectomy must be done, as otherwise lardaceous disease or hectic may carry off the patient, or blood-poisoning may ensue from the discharge becoming septic, or, as sometimes happens when the obstruction of the ureter is relieved to some extent by the nephrotomy, the decomposing pus may make its way into the bladder, set up cystitis, and the other kidney become affected. Under some circumstances, as where the kidney is reduced to little more than a shell, it will be better at once to perform nephrectomy.

RENAL CALCULI generally consist of uric acid or of oxalate of lime, and are formed by the deposit of the urinary salts, either in the tubules or calices of the kidney. Whilst still small, they may pass down the ureter into the bladder, and subsequently form the nucleus of a vesical calculus, or be voided with the urine. Or they may remain in the kidney, either in its substance, or in the pelvis or one of the calices, and there increase in size by the successive deposit upon them of the urinary salts. They may be single or multiple, and vary in size and shape, from that of a small rounded body the size of a mustard-seed to a large branched mass filling the pelvis and calices. Their presence may set up inflammation of the pelvis of the kidney (*calculous pyelitis*), or of its substance (*simple or suppurative nephritis*). Or they may block the ureter, in which case the kidney may become distended with altered urine (*hydronephrosis*), or with pus (*pyonephrosis*); whilst, at times, they may exist for years causing little or no damage. Not infrequently there may be a stone in both kidneys.

Symptoms.—At times there may be no symptoms, even although the stone is of large size. Generally, however, there will be pain, retraction of the testicle, increased frequency of micturition, and the presence of blood or pus in the urine. The pain, which is worse after exercise, is usually situated in the loin of the affected side, and is often felt shooting down the course of the ureter to the groin and front of the thigh. Blood is generally present in the urine from time to time, especially after violent exercise, and pus and mucus in varying quantities, if pyelitis has been set up, may also, as a rule, be detected. The urine, notwithstanding the presence of the pus, is generally acid, and the bladder, prostate, and urethra are found free from disease. Should hydronephrosis or pyonephrosis have been produced, a tumour will then be discovered in the abdomen, and there may no longer be any pus or blood in the urine. In the latter instance there may be in addition constitutional signs of suppuration (see *hydro-* and *pyonephrosis*). Should the stone escape from the pelvis and enter the ureter, its passage down that tube will be attended with intense pain (*renal colic*). The pain occurs suddenly and darts towards the groin, testicle, and thigh, and is accompanied by nausea or vomiting, syncope, profuse perspiration, and blood and urates in the urine. After lasting a few hours to several days the symptoms suddenly cease, owing to the calculus dropping from the lower end of the ureter into the bladder, or if too large to pass beyond the infundibulum, becoming displaced into the pelvis of the kidney. Hence successive attacks of renal colic may be due either to the same stone blocking up from time to time the entrance of the ureter or to the passage of different stones.

Treatment.—For an account of the preventive treatment a work on medicine must be consulted. When a stone has formed and medical treatment has failed to give relief after long-continued trial, and the patient's life is rendered unbearable from constant pain, or compulsory recumbency, an operation must be undertaken for his relief. This may consist in nephrolithotomy, nephrotomy, or nephrectomy. Where the kidney is but little if at all damaged the first is clearly indicated; but if, on exploring the kidney, the stone cannot be felt even on puncture with a needle, or incision and exploration with the finger, it becomes a question whether nephrectomy should be done, or the kidney left *in situ* and the wound merely closed. If hydronephrosis or pyonephrosis has supervened nephrotomy is required, or possibly nephrectomy. For renal colic hot baths, hot fomentations, and opium, or morphia injections must be given to assuage the pain.

THE TUBERCULOUS OR STRUMOUS KIDNEY need only briefly be referred to here, as it is more fully described in works on medicine. This affection may occur in the course of general tuberculosis, or involve the kidney secondary to the bladder or prostate; or it may begin primarily in the kidney and thence spread downwards. The *symptoms* to which it gives rise are very similar to those of renal calculus, and it may be impossible to distinguish them. Thus, there is increased frequency of micturition, pus, and at times blood, in the urine, and often pain in the loin; whilst later there will be a tumour in the abdomen with characters like those described under pyonephrosis. The presence of tubercle elsewhere, and of hectic or emaciation, and the discovery of the tubercle bacillus in the urine, will point to the nature of the case. *Treatment.*—The constitutional remedies for tubercle should be employed, and when pyonephrosis or a perinephritic abscess has formed, nephrotomy may be resorted to; but nephrectomy should never be undertaken unless it seems clear that the disease is limited to one kidney, the exception rather than the rule.

CYSTS OF THE KIDNEY.—Serous and hydatid cysts may occur in the kidney as elsewhere, but the question of their diagnosis, which is often attended with much difficulty, cannot be discussed here. They are very rare. Cysts of small size are also common in connection with some forms of chronic Bright's disease; but these only concern the pathologist. The so-called cystic degeneration, due to urinary obstruction, pyelitis, pyonephrosis, &c., has already been alluded to.

TUMOURS OF THE KIDNEY.—Sarcoma and carcinoma are the only tumours which need be referred to. They are characterized by a swelling in the region of the kidney, dulness in the flank, the presence of the colon in front of them, the absence of fluctuation unless they are of a cystic character, blood in the urine, and rapid emaciation. *Treatment.*—If the tumour is diagnosed whilst still small nephrectomy may be done, though an early recurrence is only too probable. When the tumour is of large size it is beyond the reach of legitimate surgery.

Suppression of urine is the term applied to the non-secretion of urine by the kidneys, and must not be confounded with *retention* of urine, in which the urine is secreted as usual, but its passage from the bladder is obstructed. In the former the bladder is empty; in the latter distended. Suppression as met with in surgical practice is generally due to the shock following an operation or injury in a patient suffering from chronic renal disease. If not relieved, coma, convulsions, and death from uræmia quickly ensue. *Treatment.*—Dry cupping the loins, hot vapour baths, free purging as by elaterium and croton oil, injections of pilocarpine, and hot enemata per rectum, are at times successful in relieving the congested kidney.

Operations on the Kidney.

Aspiration of the kidney may be performed either for the purpose of diagnosing a renal swelling, or for the relief of such affections as hydronephrosis, pyonephrosis, or hydatid or blood cysts. It should be done with the ordinary precautions, any prominent or fluctuating spot being chosen for the puncture.

Nephrotomy consists in making an incision into the kidney for the purpose of evacuating and draining the fluid or pus in the case of hydronephrosis, pyonephrosis, hydatid cyst, abscess, &c. The tumour may be exposed by the lumbar or lateral incision as described in nephrectomy. An incision is made into the kidney, the fluid allowed to run out, the wound thoroughly irrigated with some antiseptic solution, and insufflated with iodoform, a large-sized drainage-tube inserted into it, and voluminous dressings of absorbent cotton and the like applied to receive the subsequent discharges.

Nephro-lithotomy consists in cutting into a kidney for the purpose of extracting a calculus. The kidney may be exposed either by the lumbar or lateral incision as described in nephrectomy. If a stone is felt, an incision should be carefully made over it, the finger or forceps introduced, and the stone extracted. If one cannot be felt a needle should be thrust into the kidney at several situations, and this failing, an incision should be made into it, and the finger and a probe introduced to search for the stone. A drainage-tube should be placed in the wound, and an antiseptic and absorbent dressing applied. The urine will at first escape through the wound, but will cease to do so after a longer or shorter interval.

NEPHRECTOMY, or removal of the kidney, may be done for—1. A large renal calculus. 2. Tuberculous disease with exhausting discharge. 3. Hydronephrosis. 4. Malignant and other tumours. 5. Moveable kidney attended with severe neuralgic pain. The operation may be done without opening the peritoneum, either by a lumbar or a lateral incision, or through the peritoneal cavity, the incision being then made either in the linea alba or linea semilunaris.

The *extra-peritoneal operation.*—If the incision is made in the lumbar region it may be vertical, oblique like that of colotomy, or T-shaped. If the lateral incision is chosen it should be made obliquely from near the tip of the last rib, towards the anterior superior spine of the ilium. It is the one I have always employed myself, and one now in common use at St. Bartholomew's, its advantages being that it combines the facilities of the intra-peritoneal and the greater safety of the lumbar incision, as it does not involve opening the peritoneal cavity. The kidney having been exposed by any of these incisions, the capsule should be opened, the finger introduced, and the kidney enucleated from its capsule; the renal artery and vein should then be securely tied with a silk ligature passed round them by an aneurism needle, and the ureter secured separately in a similar way. The kidney may then be removed by cutting through the pedicle with scissors, and the wound drained and dressed antiseptically.

The *intra-peritoneal operation.*—This consists in opening the peritoneal cavity by one of the incisions mentioned above, drawing the intestines aside and then exposing the kidney by cutting through the peritoneum in front of it external to the colon. The vessels are then tied separately, the kidney removed and the peritoneum united, the same precautions being adopted as after an ovariotomy. A drain-tube is passed by some surgeons through a counter-opening in the loin, and the end of the ureter brought out of the wound.

The *dangers of nephrectomy* are—1. Severe shock. 2. Excessive hæmorrhage. 3. Suppression of urine from disease or absence of the opposite kidney. 4. Peritonitis from wounding the peritoneum. 5. Laceration of the colon. 6. Inclusion of the vena cava in the ligature of the pedicle in operating on the right side.

NEPHRORRAPHY is an operation for fixing a floating or moveable kidney by exposing the kidney in the loin, and attaching it with sutures to the parietes. It should only be done where there is intense pain and constant suffering, which palliatives have failed to relieve.

Urinary Deposits and Calculi.

URINARY DEPOSITS are divided into the unorganized and the organized. A. The *unorganized* consists of the urates, the uric acid, the oxalate of lime, the phosphates, the cystic oxide, the uric oxide and the carbonate of lime. Only the more common of these are described.

1. The *urates* formerly called *lithates* are the most common of the urinary deposits, and are formed by the combination of uric acid with ammonia, soda, or lime. They occur in acid urine as an amorphous sediment, varying in colour from a white or a pale fawn to a brick-dust red. They only appear as the urine cools, and disappear again on the application of heat, or on adding alkalies. Though generally amorphous they sometimes present the crystalline forms seen in Fig. 248.

2. The *uric acid* deposits, which are the next most common, occur only in very acid urine, as a yellowish-pink, red, or brick-dust red crystalline sediment. The crystals are often of large size, and the deposit is then known as *red sand* or *gravel*. They usually occur as rhombic prisms, or long oval plates with acute angles, and are often mixed, forming rosettes. The various kinds are seen in Fig. 249. They are soluble in alkalies. The *causes* of the presence of uric acid, as well as of the urates, are: 1. Rapid tissue waste, as in fevers; 2. Over-indulgence in animal food; 3. Dyspepsia; 4. Congestion of the kidney; 5. Gout; and 6. Want of action of the skin.

3. The *oxalate of lime* is a crystalline deposit and assumes two forms, the octahedral and the dumb-bell crystals (Fig. 250). On holding the urine up to the light the crystals as minute shining particles are seen in it. The *causes* are: 1. Nervous exhaustion from overwork or sexual

excesses. 2. Dyspepsia induced by saccharine food, excess of alcohol, or vegetable diet.

4. *Phosphatic* deposits occur in three forms, (*a*) phosphate of lime, (*b*) phosphate of ammonia and magnesia, or triple phosphates, (*c*) the two former mixed, or the fusible phosphates. (*a*) *Phosphate of lime* forms a white cloud or amorphous deposit of pale granules or spheroids, two of which adhering form the so-called false dumb-bell; or a

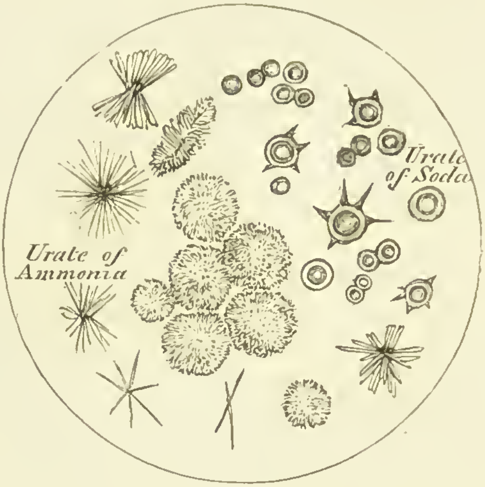


Fig. 248.—Urates. (Bryant's Surgery.)

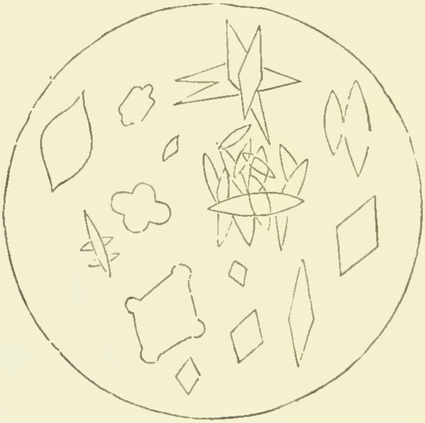


Fig. 249.—Uric acid crystals. (Bryant's Surgery.)

crystalline deposit of six-sided prisms collected into sheaths or bundles (Fig. 251). It may be mistaken for albumen, or when in considerable quantities for pus or mucus. The urine is always alkaline. (*b*) The *ammonio-magnesian phosphates* occur in the form of large triangular prisms with truncated extremities; as four-sided prisms; as six-sided plates; and as foliaceous stellar prisms on

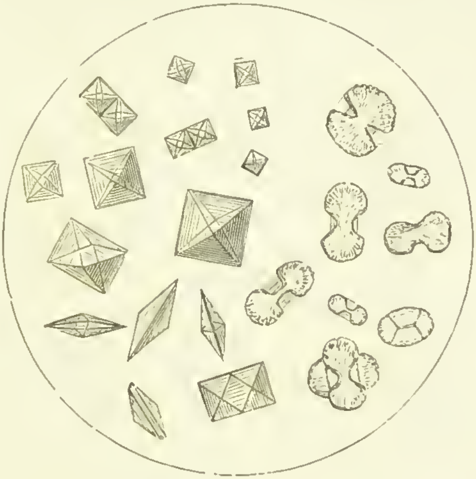


FIG. 250.—Crystals of oxalate of lime. (Bryant's Surgery.)

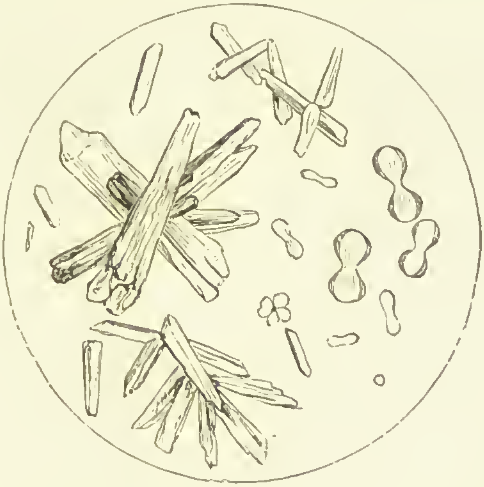


FIG. 251.—Phosphates of lime. (Bryant's Surgery.)

adding ammonia (Fig. 252). The urine is natural in colour, neutral or acid, rarely alkaline, and has a fœtid ammoniacal odour. *Causes.*—Phosphatic deposits are due to local disease or injury of the urinary organs, such as may be induced by spinal mischief, a foreign body in the bladder, &c. The mucus from the bladder decomposes the urea into carbonate of ammonia, which converts the soluble acid into insoluble alkaline phosphates.

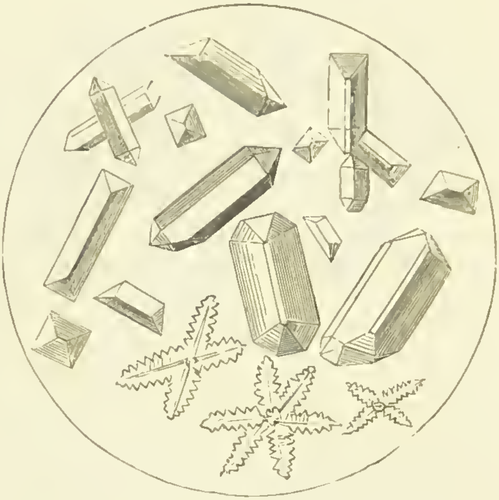


Fig. 252.—Phosphates of ammonia and magnesia (triple phosphates.) (Bryant's Surgery.)

Carbonate of lime, *cystic oxide*, and *uric oxide*, are too rare to require description.

B. *The organized deposits.*—To these belong pus, blood, mucus, epithelium, renal casts, spermatozoa, and fungi. *Pus* occurs as a thick sediment and may be known by the urine becoming gelatinous and ropy on adding liquor potassæ; by its containing albumen; and by the microscopical appearance of the pus-corpuscles (p. 20). It may be due to cystitis, pyelitis, gonorrhœa, leucorrhœa, and abscess in any part of the urinary tract. *Blood* may be recognised by the urine being smoky or red, by the ozonic ether test, and by the microscope. See *Hæmaturia* (p. 708). *Mucus*, *epithelium*, *renal casts*, and *spermatozoa*, may be detected by the microscope.

Urinary calculi are commonly spoken of as renal, vesical and prostatic, according as they occur in the kidney, bladder or prostate. *Renal calculi* are formed in the kidney and have already been described (p. 676). *Prostatic calculi* are formed in the racemose glands of the prostate, and will be further referred to under diseases of that organ (p. 713). *Vesical calculi* may originate in the bladder, or as is more commonly the case, in the kidney, whence they pass into the bladder, and there increase in size by the successive deposit upon them of the same or other of the urinary salts. The calculi most frequently met with in this situation are (1) the uric acid; (2) the oxalate of lime, and (3) the fusible or mixed phosphates. The rarer forms are (4) the urate of ammonia; (5) the cystic oxide or cystine; (6) the phosphate of lime; (7) the phosphate of ammonia and magnesia, or triple phosphate; (8) the carbonate of lime; (9) the xanthic or uric oxide; (10) the fibrinous; (11) the blood; (12) the uro-stealith, and (13) the silicious. The seven latter, being exceedingly rare, are not described.

1. THE URIC ACID CALCULI are the most common. They are generally of moderate size, oval, and laterally compressed, of a nut-brown colour, smooth or finely granular, moderately heavy and hard, and laminated on section. They are completely destroyed in the blow-pipe flame, giving off a smell of burnt feathers. They are insoluble in nitro-hydrochloric acid, but soluble in warm alkalies. When treated by nitric acid and evaporated to dryness, on the addition of a drop of ammonia a purple colour is produced (*murexide test*). The nucleus is generally composed of uric acid, sometimes of oxalate of lime, and is generally formed in the kidney. These calculi occur most frequently in *youth* and middle age.

2. THE OXALATE OF LIME, OR MULBERRY CALCULI as they are often called from their resemblance, when first removed covered with blood from the bladder, to a mulberry, are generally of moderate size, globular in shape, usually of a dark-brown or mahogany colour, rough and tuberculated, very hard and heavy, and crystalline on section. They are only partially destroyed in the blow-pipe flame, the residue being alkaline and effervescing with an acid. They are insoluble in acetic acid, but soluble in hydrochloric acid. The nucleus is generally composed of oxalate of lime, but may consist of uric acid or urate of ammonia. It is usually formed in the kidney. These calculi are most frequent in *middle age*.

3. THE PHOSPHATIC CALCULI are of three kinds:—(*a*) the phosphate of lime or earthy phosphate; (*b*) the ammonio-magnesian or triple phosphate, and (*c*) the phosphate of lime with the ammonio-magnesian phosphate, the mixed or fusible phosphate. Of these the last is the only common form. It is usually of large size and of white colour, smooth, soft, friable, earthy and laminated on section, and of irregular shape, taking that of the nucleus on which it is formed; it fuses when heated in the blow-pipe flame; is insoluble in warm alkalies, but is soluble in acetic acid. The nucleus is composed of uric acid, oxalate of lime, or of some foreign body other than a calculus, as a piece of catheter, hair-pin, blood, or fibrin. It occurs most frequently in the *later* periods of life, and is then generally produced as follows:—A calculus or other foreign body irritates the mucous membrane of the bladder, and a secretion of mucus is, in consequence, poured out. This mucus decomposes the urea contained in the urine into carbonate of ammonia and water. The carbonate of ammonia unites with the acid phosphates, and an insoluble mixed phosphate of ammonia, magnesia, and lime is thrown down and deposited on the foreign body. Hence these calculi are only met with in alkaline conditions of the urine.

Although calculi may be chiefly composed of one constituent, they are more often composed of several, which may be arranged in alternate layers (*alternating calculus*). The formation of these layers is due to the varying state of the patient's health, and of the condition of the mucous membrane of the bladder.

DISEASES OF THE BLADDER.

EXTROVERSION or ECTOPIA VESICÆ is a malformation in which, in consequence of an arrest in the development of the anterior wall of the bladder and the corresponding part of the abdominal parietes, the posterior wall of the bladder is pushed forward by the pressure of the abdominal viscera, and protrudes as a red velvety tumour. It is associated with epispadias or absence of the upper wall of the urethra, and with failure of union of the pubic bones at the symphysis. The testicles are frequently retained in folds like the labia on either side. It is attended with extreme discomfort from the constant dribbling away of the urine from the mouths of the ureters, which can be seen on the surface of the tumour. *Treatment.*—Many operations having for their object the closing in of the bladder by flaps of skin taken from the adjacent abdominal wall, have been performed for the relief or cure of the deformity. Various attempts have also been made to turn the ureters into the colon or rectum, but without success. Recently Trendelenberg has succeeded in reducing the gap between the pubic bones by separating the sacro-iliac synchondroses, so that he was enabled at a subsequent sitting to bring the mucous surfaces of the bladder in contact, and then unite them by a plastic operation. The newly formed bladder is in this way lined with mucous membrane instead of having its front wall closed in by skin, the objection to which is the growth of hair at puberty and its incrustation with phosphates.

CYSTITIS, or Inflammation of the Bladder, may vary from the mildest catarrh to the most intense inflammation involving not only the mucous membrane but the other coats of the organ as well. For the purpose of description, however, it may be divided into the Acute and Chronic.

ACUTE CYSTITIS. *Causes.*—In its most intense form it is nearly always the result of injury or operation, as the passage of instruments, irritation of sharp fragments of a crushed calculus, &c. In its milder forms it may be due to the extension of inflammation from the urethra as in gonorrhœa, or from the ureters in calculous pyelitis; to the exhibition of certain medicines, as cantharides; and occasionally in gouty subjects to exposure to cold.

Symptoms.—In the acutest forms there is intense pain, and strangury, or a continual desire to void urine, which is passed drop by drop in a spasmodic manner; whilst there is high fever, rapidly running into a typhoid type. In the less acute or more common forms micturition is still very frequent, with increased pain, as soon as a little urine has collected in the bladder, in consequence of the stretching of the inflamed mucous membrane. The urine is scanty, high-coloured, often blood-stained, and mixed with mucus and pus. The fever, though generally high, is less marked than in the acuter cases, and may be of a more transitory character.

Pathology.—In the milder forms the inflammation is limited to the neck of the bladder and to the mucous membrane only. In the worst forms it involves the whole bladder, and extends to the muscular or even the peritoneal coat. It may terminate in 1, resolution; 2, chronic cystitis; 3, ulceration or gangrene of the mucous membrane; 4, abscess in the walls of the bladder; 5, inflammation of the kidneys, or more rarely of the peritoneum; and 6, sapræmia, produced by the absorption of the products of the decomposing urine.

Treatment.—The cause, if possible, should be removed. Thus, if there are fragments of calculus in the bladder, they should at once be extracted by the large evacuating catheter, crushing any that cannot be got away; or perhaps better, the bladder may be opened by a median incision in the perinæum and thoroughly washed out. If a catheter has been tied in it should at once be withdrawn. Hot sitz-baths should be given night and morning, leeches applied to the perinæum, suppositories of morphia placed in the rectum, and hyoscyamus and alkalies, if the urine be acid, administered to relieve strangury. All stimulants should be avoided, the diet restricted to milk, and the bladder washed out with hot water, or when the urine is decomposed, with a weak antiseptic lotion. If washing out increases the irritation, the bladder should be drained by an incision in the perinæum.

CHRONIC CYSTITIS is much more frequent than the acute variety, and in its mildest form is known as catarrh of the bladder. *Causes.*—It may be a sequel to an acute attack; or it may be chronic from the commencement, and may then be due to a stone or other foreign body or a growth in the bladder, obstruction to the urinary outflow, as from an enlarged prostate or stricture of the urethra, the extension of gonorrhœa, paralysis, overdistension or atony of the bladder, or the spread of inflammation from the neighbouring organs.

The symptoms are similar to those of acute cystitis, but are much milder in intensity. Thus there is increased frequency of micturition, the patient, perhaps, having to make water every hour or half-hour, the desire to do so being generally so urgent that he is unable to control it. This, as in the acute variety, is due to the stretching of the inflamed mucous membrane as soon as a few ounces of urine collect. The pain usually ceases immediately the bladder is relieved. The urine is characteristic; it generally contains large quantities of ropy mucus and pus, which form, on standing, a distinct layer at the bottom of the containing vessel. It is often alkaline, and sometimes highly ammoniacal and offensive from the decomposition of the urea into carbonate of ammonia. This decomposition is brought about by fermentation, probably set up by the presence of micro-organisms that have gained admission either by the use of a contaminated catheter, or by making their way along tho stringy mucus that may hang about the urethra. *Pathology.*—The mucous membrane is thickened, velvety, mottled with patches of a dark slate, or red colour, and may be covered with muco-pus and sometimes with a deposit of phosphates, or it may even, in places, be destroyed by ulceration. The muscular coat, where there has been obstruction to the outflow, becomes thickened and fasciculated, the hypertrophied fibres giving the interior of the bladder a columnar and rugose appearance. In places the mucous membrane may protrude between the fasciculi of the muscular coat forming sacculi which may become receptacles for urine, and in which calculi may form. If the cystitis is allowed to continue the kidneys may subsequently become affected.

Treatment.—As in the acute form the cause, as stricture, stone, &c., must first be removed, as where this is impracticable, the treatment at best can only be palliative. The diet should be unstimulating, and alcohol in any form, as a rule, forbidden. A purely milk diet is at times most successful. Internally, such medicines as buchu, uva ursi, balsam of copaiva, and chlorate of potash should be given where thick ropy mucus is passed with the urine; and benzoic acid which, in its passage through the system is converted into hippuric acid, may be tried when the urine is alkaline. Locally, the bladder should be washed out twice a day with some antiseptic solution, as boric acid, nitric acid, corrosive sublimate, quinine, &c. The best results are sometimes obtained from water as hot as can be borne. Great care should be taken that all instruments are rendered thoroughly aseptic before use. In severe cases, where other means have failed, the bladder should be placed at rest by perinæal cystotomy and drainage for some weeks.

Irritability of the bladder, by which is meant a too frequent passing of water, is often spoken of as a disease; but is no more so than is pain, since it is only a symptom either of disease of the urinary organs, or of some general state of the system, as hysteria, Bright's disease, &c. The cause should be sought and treated.

Inversion of the bladder, and hernia of the bladder, are both very rare, and are not here described.

Atony and paralysis of the bladder. Both these terms are applied to a want of contractile power in the muscular coat to expel the contents of the bladder; but in *atony* the want of power is the result of loss of tone in the muscular fibres, while *paralysis* is due to the failure of nervous influence. Both conditions must be distinguished from the mere inability of the bladder to empty itself on account of obstruction to its outlet. (See *Retention.*)

Atony may be due to, 1. Simple over-distension, consequent upon the patient having voluntarily or compulsorily held his urine for too long a period, whereby the muscular fibres are over-stretched and unable to recover themselves. 2. It may be the result of gradual distension owing to enlarged prostate or stricture. In consequence of the obstruction, the bladder does not empty itself, but some urine remains after every act of micturition; the amount retained gradually increases, the bladder becomes distended, and its fibres, if the patient is old, become stretched, and lose their tone instead of becoming hypertrophied as commonly happens in a young and healthy person. 3. Again, atony may be due to cystitis, owing to the inflammation having spread to the muscular coat, which then undergoes fibroid or fatty changes.

Symptoms.—The patient complains of inability to hold his urine, or that it constantly dribbles away, or that he has to pass it very frequently. The involuntary flow occurs at first during sleep; afterwards on any exertion causing contraction of the abdominal muscles. These symptoms, although often spoken of as incontinence, are really those of retention, the bladder being fully distended, but unable to empty itself, and the excess flowing involuntarily away.

The *treatment* consists in passing a catheter at regular intervals and as often as may be necessary to completely empty the bladder; whilst in the meantime, the condition leading to the atony must be treated by appropriate means. Thus, if the result of over-distension, strychnine and galvanism may be tried; if the result of gradual distension from enlarged prostate or stricture, these conditions must be treated in the way mentioned under their respective heads. In both paralysis and atony, cystitis, dilatation of the ureters, pyelitis, and disorganization of the kidney rapidly ensue if the cause of the bladder trouble cannot be relieved.

True paralysis of the bladder is nearly always the result of disease or injury of the brain or spinal cord, and is not met with except in general paralysis. The bladder being paralysed cannot empty itself, and becomes distended as in atony; and when it can hold no more, the excess overflows through the sphincter, which is also paralyzed. *Reflex paralysis*, however, often occurs after an injury or surgical operation, especially that for hæmorrhoids. The local *treatment* consists in the regular passage of a catheter two or three times daily.

TUBERCLE OF THE BLADDER is rare, and is nearly always secondary to tubercle in other parts of the genito-urinary tract. There is pain, hæmorrhage, and other signs of chronic cystitis; but the diagnosis will depend rather on the exclusion of other diseases such as stone, tumours, &c., and the presence of tubercle in other organs. *Treatment.*—General constitutional remedies for tubercle, and such local remedies as are indicated for cystitis, and for the assuaging of the pain.

VESICO-INTESTINAL FISTULA may be known by the occasional passage of fæcal matter and gas by the urethra, and is usually a source of great discomfort. It commonly depends on malignant or other form of ulceration of the intestine involving the bladder. *Treatment.*—When the fistula is thought to be low down the intestine the abdomen may be explored, and the colon above the fistula united to the abdominal wall and then opened.

THE TUMOURS that may be met with in the bladder are:—1. *The fibrous.* 2. *The mucous.* 3. *The villous or papillomatous.* 4. *The malignant.* The *fibrous* and *mucous* spring from the sub-mucous coat, and protruding the mucous membrane in front of them assume a polypoid or warty shape. They are very rare. *The villous or papillomatous* spring from the mucous membrane, and appear as soft, flocculent growths resembling the villi of the chorion. They are the most common of the innocent growths. *The malignant* either spring from the mucous or the sub-mucous coat, and may form a large mass often nearly filling the bladder, or assume a villous appearance, or merely infiltrate the walls. They have either a carcinomatous or sarcomatous structure.

The *symptoms* common to all are those of a foreign body in the bladder, with hæmaturia and absence on sounding of stone. In the *fibrous* there are signs of obstruction to the urinary outlet, but little or no hæmaturia, and the tumour may sometimes be felt with the sound. In the *villous* there is usually more or less continuous hæmorrhage without any other cause being discoverable to account for it; there is seldom any marked obstruction to the urinary outflow; and shreds of the growth may come away spontaneously or in the eye of the catheter. In the *malignant* there are usually sudden attacks of severe hæmorrhage from time to time; and a growth may be felt by the sound, or by the finger in the rectum; or by palpation above the pubes. There are commonly moreover other signs of malignancy, as rapid growth of the tumour, cachexia, &c. Tumours of the bladder, however, especially the villous, are often difficult to diagnose; some aid, it is true, may at times be gained by the electric endoscope, but where the urine contains blood it is of little or no service, although attempts have been made to overcome this by passing a stream of water through the instrument. Indeed, in some cases, a diagnosis cannot always be made without a digital exploration of the bladder, which should be undertaken where symptoms such as the above are persistent unless they point to the growth being of a malignant nature.

Treatment.—The removal of the tumour, except it is malignant, should generally be attempted. In the female the urethra should be dilated for this purpose. In the male the incision into the bladder should be made either above the pubes or through the perinæum as for lateral or median lithotomy. The supra-pubic incision, however, has the advantage that a more thorough extirpation can by its means be generally made. When removal is contra-indicated, relief where there is obstruction to the urinary outlet may be obtained by supra-pubic puncture; hæmorrhage should be restrained by astringents; and pain assuaged by opium.

Stone in the bladder may occur at any age, but is said to be most frequent between the ages of fifty and seventy; next, between the ages of two and six; whilst, between the ages of twenty-six and thirty-six it is rare. It may occur in both males and females, but is decidedly more common in the former.

The *causes* are not altogether known; but residence in certain districts or countries, poor living, abuse of alcohol, especially in the form of malt liquor, excess of nitrogenous food, want of sufficient exercise, and anything that induces the excessive formation of uric or oxalic acid in the urine, are regarded as predisposing causes. Retention of urine from prostatic enlargement and the presence of a foreign body in the bladder are the exciting causes.

Varieties.—The three most common varieties of calculi met with in the bladder are the uric acid, the oxalate of lime, and the phosphatic. They may occur almost pure, or they may be mixed. According to Sir Henry Thompson the uric acid and urates form one half of the number met with; the phosphatic one quarter; the mixed one quarter; and the oxalates only three per cent. of the whole. The uric acid and the oxalate of lime are generally formed on a nucleus of one of these substances which has descended from the kidney. The phosphatic is formed in the bladder itself, either on a nucleus of phosphates deposited on some inspissated mucus or a foreign body, or on one of the other forms of stone which has descended from the kidney and which sooner or later acts as a foreign body. The oxalate of lime is the most slow of formation and is consequently the hardest and most compact. The phosphatic forms very rapidly, is soft and friable, and often of very large size. Sometimes alternate layers of uric acid, oxalate of lime, and phosphates, occur in the same stone (*alternating calculus*), a condition probably due to varying states of the patient's health, effects of medicines, bladder irritation, &c. A description of the various forms of calculi is given in the section on *Urinary Calculi* (page 684).

The *character* of the stone may to some extent be guessed at by the state of the urine. Thus, if the urine is acid, it will probably be either oxalate of lime or uric acid; if alkaline, phosphatic. Calculi vary in size from that of a hemp-seed to a large mass weighing many ounces; but large stones, at the present day, in consequence of improved diagnosis, and the less dread a patient has of an operation, are the exception. They generally occur singly, but there may be two, or even more; they are then usually facetted from rubbing against one another.

Spontaneous fracture sometimes happens, and has been attributed: 1, to the swelling of the cementing material with which the particles of the calculus are held together; 2, to two stones coming into collision; 3, to the compression of the calculi by the hypertrophied muscular coat of the bladder.

The calculus may be variously situated in the bladder. It is usually free just behind the prostate, but it may be in the upper fundus behind the pubes, or in one of the sacculi so often found in long-standing disease of the bladder. Calculous matter may sometimes be deposited upon growths in the bladder or upon the ulcerated mucous membrane.

The *terminations of stone.*—If neglected, cystitis is set up, and inflammation may spread up the ureters to the kidneys, leading to the changes described under surgical diseases of the kidneys. In consequence, moreover, of the obstruction to the urinary outlet, the bladder may become hypertrophied, and the ureters and kidneys dilated in the way described under *stricture.*

Symptoms.—The three chief symptoms are—1. Pain, generally referred to the end of the penis, and worse after micturition, on account of the stone then falling on the sensitive trigone, and the walls of the bladder contracting upon it. 2. Frequent micturition; and, 3. A little blood in the urine. These symptoms are increased on exercise, especially riding, and after the jolting of a railway journey, &c., and are least marked at night when the patient is at rest. Other symptoms that may be present are the passage of gravel; sudden stoppage of the stream during micturition; the presence of muco-pus in the urine owing to cystitis; piles in adults and prolapse of the rectum in children, due to straining; and elongation of the prepuce in boys caused by the constant handling to relieve pain after micturition. Stone in the bladder may be simulated by cystitis, an enlarged prostate, a long or adherent prepuce, a narrow meatus, a growth in the bladder, calculous or other disease of the kidney, a peculiar choreic condition of the bladder (the stammering bladder of Sir James Paget), tubercle in the bladder, and ascarides in the rectum. An accurate diagnosis, however, can only be made by sounding the bladder; though in boys the stone may be felt by the finger in the rectum whilst pressure is made with the other hand above the pubes.

Sounding the bladder.—The ordinary sound (Fig. 253) is a solid steel instrument with a short bulbous beak. Thompson's sound is hollow, to allow some of the urine to be drawn off if desired, and has a handle like that of his lithotrite, to facilitate the necessary movements in the bladder. Having warmed and oiled the sound, pass it like a catheter, letting it glide into the bladder, by its own weight without using any force. When the sound is in, gently push it onwards to examine the posterior part of the bladder. Then turn the beak alternately to either side; and depress the handle between the patient's thighs to search the upper fundus. Then turn the beak downwards to examine the base or lower fundus. If the stone is not detected, let out a little of the urine, or change the patient's position, or raise his pelvis and try again. The stone may not be felt, because it is of small size, or has become encysted, or entangled in a fold of mucous membrane. A guarded opinion, therefore, should be given, and a further examination made another day. A stone may be known to be present by the peculiar ring which is both felt and heard on striking it. This ring is quite unlike the sensation given to the sound by its coming into contact with phosphatic deposits on a roughened or fasciculated bladder, or with one of the pelvic bones. Having discovered a stone, the next care should be to determine approximately—1, its probable size and composition; 2, whether it is free or encysted; 3, whether there is one stone or more; and, 4, the condition of the bladder and urethra. 1. The *size of the stone* can be roughly estimated by the amount of resistance offered on pushing it before the sound or by passing the sound over it, and by feeling it through the rectum with the other hand pressing on the hypogastrium. Its exact size can only be ascertained by seizing it with the lithotrite, the distance the blades are then apart being indicated by the scale on the handle. The *composition of the stone* may be approximately arrived at by (*a*) the character of the ring on striking it—the clearer the ring the harder the stone, (*b*) the condition of the surface, which is rough in the oxalate of lime, smooth in the phosphatic, (*c*) the re-actions of the urine, and (*d*), the general health of the patient. 2. A *stone, when encysted,*

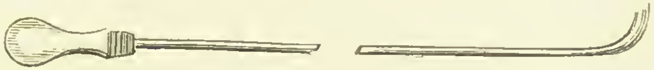


Fig. 253.—Ordinary sound.

is always felt at the same spot in the bladder, and when seized with the lithotrite cannot be moved. The sound cannot be passed all round it. There is no blood present, and the symptoms are usually less severe, and are not increased by exercise. 3. The *presence of a second stone* can only be determined with certainty by seizing one stone with the lithotrite, and then striking the other.

Treatment.—The stone may be removed by crushing (*lithotrity*), or cutting (*lithotomy*). In adults, lithotrity, with but few exceptions, should be the rule. In children, up to twelve or fourteen years of age, lithotomy has hitherto been the recognized operation; but I believe that when the brilliant results obtained by Surgeon-Major Keegan and others come to be better known, that even in very young children, lithotrity, as in adults, will also be the rule, lithotomy the exception. I have myself crushed six or seven stones in young male children, some as young as three years. In adults, lithotomy should be practised in place of lithotrity, when 1, the stone is very large and hard; 2, when the urethra is the seat of intractable stricture; 3, when the stone is encysted; and 4, when the bladder is sacculated. A large stone, if soft, should be crushed, and a hard stone, if not too large, is no bar to the operation. Surgeon-Major Keegan has crushed a uric acid stone, the fragments of which weighed two ounces and three quarters, and an oxalate of lime which weighed one ounce and three drachms. And in a boy, aged thirteen, I crushed and successfully removed a very hard stone weighing only a few grains less than an ounce. Hard stones, however, weighing above an ounce, and especially in boys, had better be removed by cutting, unless the Surgeon is experienced in lithotrity. Cystitis and kidney disease render the prognosis of both operations unfavourable; but in these affections it does not appear that crushing with complete removal of the fragments, is attended with more risk than is lithotomy. A large prostate renders lithotrity difficult no doubt, but does not, as a rule, contra-indicate it. Stricture of the urethra is only an impediment to lithotrity when the stricture cannot be dilated. The conditions, however, most favourable for success in lithotrity are, as well expressed by Sir Henry Thompson, "a capacious and not very tender urethra, a bladder capable of retaining three or four ounces of urine, absence of ordinary signs of renal disease, and fair general health."

LITHOTRITY, LITHOLAPAXY, OR BIGELOW'S OPERATION, consists in crushing the stone in the bladder, and removing the *whole* of the fragments through a large evacuating catheter. Formerly, it was taught that the presence of the lithotrite in the bladder for more than a few minutes at a time was productive of great irritation, and it was consequently advised that the crushing of the stone should be extended over several sittings of only a few minutes each, and the fragments allowed to be passed by the natural efforts of the patient. To Professor Bigelow is undoubtedly due the credit of having enunciated the principle that the bladder is not so intolerant of instruments as was formerly supposed, and that it was to the presence of the fragments, rather than to the lithotrite, that the irritation, cystitis, &c., so common after the old method, should be ascribed.

The operation.—The patient having been prepared for the operation by careful attention to the general health, rest, and such local means for allaying chronic cystitis as were pointed out under that head, should be placed under an anæsthetic, with the pelvis raised a few inches, the thighs slightly apart, the knees supported on a pillow, and the body and legs well wrapped up in blankets to avoid a chill. The rectum should be emptied by a purge the day before, and by an enema on the morning of the operation. A few ounces of urine in the bladder is desirable. If necessary, incise the meatus (a stricture, if present, should have previously been dilated), warm and oil the lithotrite (Fig. 254), and pass it with all gentleness, letting it glide by its own weight through the spongy and membraneous portion of the urethra, and do not depress the handle till the blades have reached the prostate. Then bring the shaft to an angle of 35° with the horizon, and it will glide through the prostatic urethra, over the trigone of the bladder, and may possibly be felt to graze the stone. The blades now rest in the lowest part of the bladder and point upwards (Fig. 255). Hold the handle tightly with the left hand, and, without moving the instrument, open

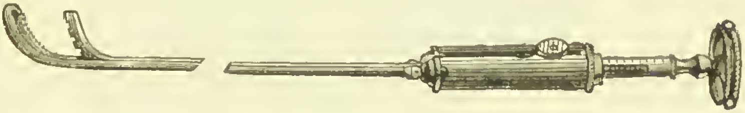


FIG. 254.—Thompson's Lithotrite.

the male blade by drawing out the wheel-shaped end with the right hand. Pause a few seconds to allow the currents set up in the urine by this movement to subside. Then gently press in the male blade, and the stone will probably be caught. If so, continue the pressure on the wheel

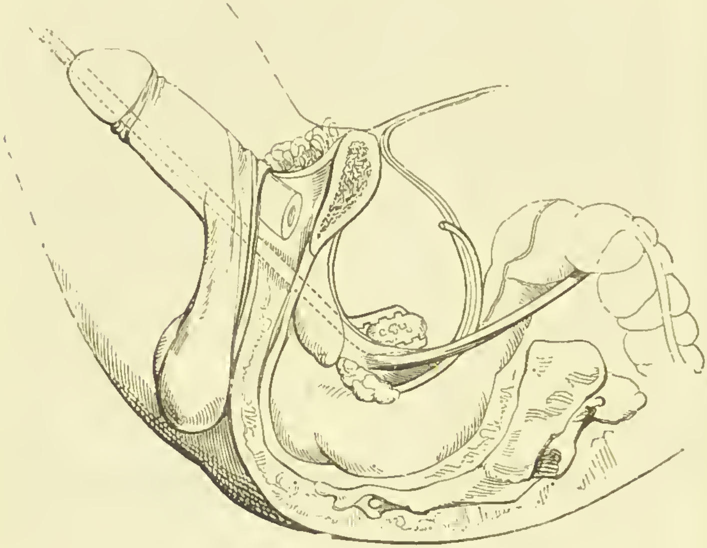


FIG. 255.—Lithotrite in situ. (Liston's Surgery.)

to retain the stone between the blades, whilst the button is moved by the thumb to convert the sliding into the screw movement. Rotate the instrument slightly to make sure that the mucous membrane is not caught by the blades; slightly depress the handle to raise the blades from the wall of the bladder, and screw home. The stone will probably be felt to crack and break into fragments. If the stone cannot be seized in this way, systematically explore the bladder thus:—Open the blades and rotate 45 degrees; pause and close. Do this first to the right, then to the left. Then raise the blades slightly by depressing the handle; rotate alternately to right and left 90 degrees; further raise the blades and rotate 135 degrees. Finally, reverse the blades by rotating half a circle. In this way the stone will probably be found. In these manœuvres the blades should be opened before rotating them in order that the stone may not be displaced by the male blade, and after rotating a pause should be made before closing them to allow the currents to subside. Having crushed the stone and larger fragments, withdraw the lithotrite, first screwing tight home to ensure complete closure of the blades in order to prevent laceration of the urethra. Next introduce a large evacuating catheter (No. 16, or larger); let the urine escape and inject two or three ounces of warm water. Attach the aspirator, previously filled with water at a temperature of 98°, and compress the india-rubber bulb, driving some of the water into the bladder. Let the bulb expand and the outward current will bring away some of the fragments and *débris,* which will fall into the receiver and be prevented from returning into the bladder by the trap (see Fig. 256) on again compressing the bulb. Continue compressing and relaxing till the fragments cease to come away. Then if any are felt by the evacuating catheter, reintroduce the lithotrite, or a smaller one, and crush again and aspirate as before; repeating this *till all the fragments are removed.* The operation frequently lasts for an hour to an hour and a half or longer.

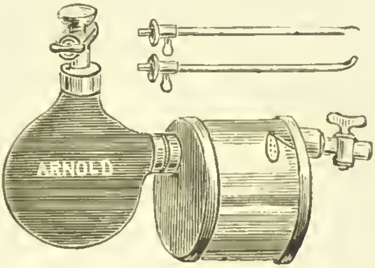


Fig. 256.—Thompson's improved evacuator and trap.

After-treatment.—Opium, if no serious kidney disease is present, may be given; and hot hip-baths if there is much pain. If there is retention the catheter should be used at regular times, or tied in, if passing it causes much irritation and pain. Complete rest for a few days or longer should be enjoined. If cystitis follows the operation, Sir Henry Thompson strongly recommends a weak injection of nitrate of silver (gr. i. to f℥i.). As a rule, however, I have found no after-treatment required, even in young boys. Indeed in several cases the child has been up and playing about the ward the day after the operation.

After-complications.—1. Rigors and fever, 2, retention of urine, 3, acute cystitis, 4, prostatitis and abscess, and 5, orchitis and epididymitis, occasionally occur. More rarely, 6, hæmorrhage, 7, suppression of urine, and 8, phlebitis of the prostatic plexus of veins, followed by pyæmia. The impaction of a fragment of the calculus in the urethra (formerly common when the fragments were left in the bladder), cannot occur if the bladder has been thoroughly evacuated.

Causes of death.—Death may occur from 1. Acute nephritis; 2. Pyelitis; 3. Cystitis; 4. Perforation of the bladder; 5. Peritonitis; 6. Sapræmia or pyæmia, or 7. Exhaustion. But a fatal termination is rare except when there is some chronic kidney disease.

LITHOTOMY, or cutting for the stone, may be performed through *the perineum* or above *the pubes*. Perinæal lithotomy may be done in many ways; the lateral as usually performed, and the median will only be described.

LATERAL LITHOTOMY.—The patient should be prepared by rest in bed for a few days, and the rectum cleared by a mild purgative the day before, and by an enema on the morning of the operation. The bladder should contain five or six ounces of urine, or if the patient is unable to retain so much an equal quantity of warm water should be injected. Anæsthetize the patient, introduce a full-size staff with a groove on the left side into the bladder, and try to strike the stone. If the stone is not felt, withdraw the staff and pass a sound. If still unsuccessful, send the patient back to bed as the stone may have been passed per urethram or become encysted. If felt by the sound, re-introduce the staff, but do *not* operate until the staff itself strikes the stone that you may be sure that the staff has passed into the bladder, and not into a false passage. It is usual to ask an assistant to strike the stone also. Next, place the patient in the lithotomy position, *i.e.*, with the soles of the feet secured in the palms of the hands by the lithotomy shackles, and bring his nates well over the end of the table. Entrust the staff to an assistant, who should hold it perpendicularly with its concavity hooked well up under the pubes and exactly in the middle line. Seat yourself in front of the patient, and having introduced the left forefinger into the rectum to make sure that it is empty, and to induce it to contract, enter the knife (Fig. 257) which should be held horizontally, a little to the left of the middle line and about an inch and a quarter in front of the verge of the anus, and carry the incision downwards and to the left to a point one-third nearer to the tuberosity of the ischium than to the margin of the anus. Pass the left forefinger into the upper angle of the wound and feel for the staff; divide with the knife the superimposed tissues; insert the finger-nail into the groove in the staff, the back of the finger being to the patient's left; and guided by the nail press the point of the knife into the groove just in front of the membraneous portion of the urethra (Fig. 258). Now run the knife with the point pressed firmly in the groove onwards into the bladder, keeping its blade well lateralized, *i.e.*, directed downwards and to the left. Take care not to depress the handle too much for fear of cutting the prostate too widely, nor to hold it too horizontal lest the point slip out of the groove and penetrate the tissues between the bladder and the rectum. Having entered the bladder, slightly enlarge the wound in the prostate in withdrawing the knife, and pass the left forefinger, which is in the wound,

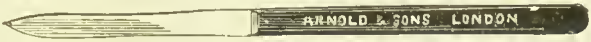


Fig. 257.—Lithotomy knife.

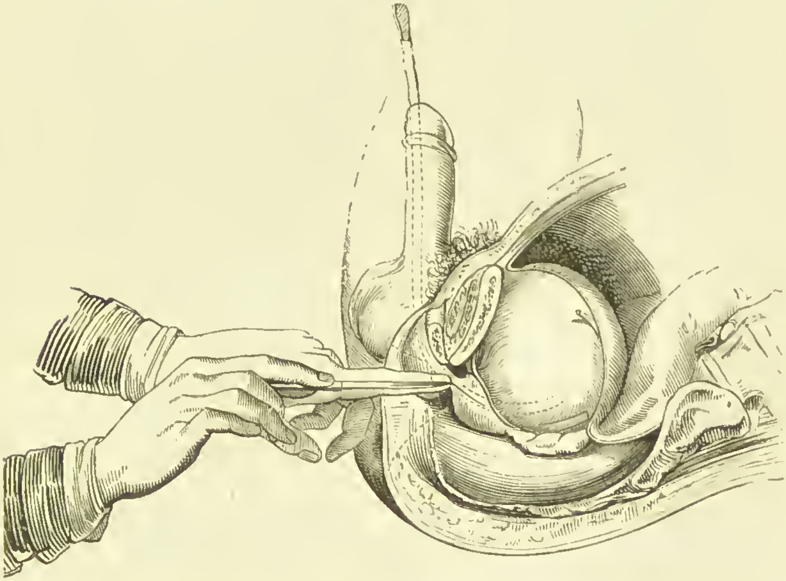


Fig. 258.—Parts cut in lithotomy. (Fergusson's Surgery.)

onwards along the staff into the bladder. If the stone is felt by the finger ask the assistant to withdraw the staff. Take the forceps in the right hand, pass them along the left forefinger towards the bladder, and, on withdrawing the finger, open the blades, and the stone will probably be driven by the gush of urine between them. Having assured yourself that the stone is grasped by the forceps in its smallest diameter, extract it by making traction downwards and backwards in the axis of the pelvic outlet. Re-introduce the finger into the bladder to ascertain whether there may not be another stone, and if in doubt use the searcher. Inject two or three syringefuls of cold water into the bladder; dust the wound with iodoform; apply no dressings; tie the legs together if the patient is a child, and send him back to bed as quickly as possible. If there is hæmorrhage, tie any bleeding point which is seen, or if the blood comes from the deep part of the wound, introduce the petticoated tube (Fig. 259), assuring yourself that the end is in the bladder by injecting water and passing a probe through it. Then plug firmly round with strips of lint between the petticoat and the tube.

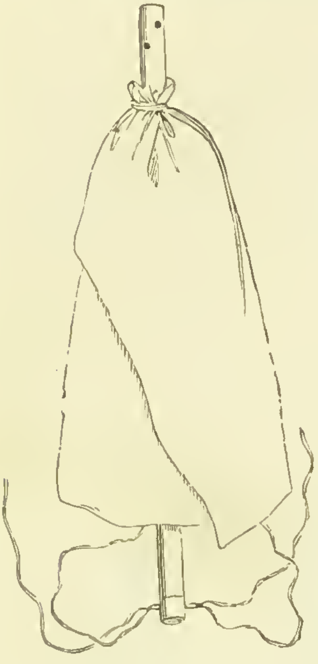


FIG. 259.—Petticoated tube.

At Guy's Hospital lateral lithotomy is performed on a straight staff, by the operation known as Key's. A good description of the method will be found in Bryant's Surgery.

The *structures divided in the operation* are—1, the skin; 2, the superficial and deep fascia; 3, a few branches of the external hæmorrhoidal vessels and nerves; 4, the transversus perinei muscle, vessels, and nerve; 5, a few fibres of the accelerator urinæ and levator ani muscles; 6, the compressor urethræ muscle; 7, the membraneous portion of the urethra; and 8, the prostate.

The dangers of the operations are:—A. *Before the point of the knife has entered the groove in the staff*—1, wounding the rectum, either from cutting too perpendicularly, or from not having had it cleared out by an enema; 2, wounding the artery of the bulb in consequence of beginning the incision too high, or directing the point of the knife subsequently too much upwards; and 3, missing the groove in the staff. B. *On entering the bladder*—1, letting the point of the knife slip out of the groove in the staff and enter the cellular tissue between the bladder and rectum; 2, cutting the pudic artery from holding the knife too much lateralized; 3, sending the point of the knife through the posterior wall of the bladder; 4, cutting the prostate too widely, and dividing its capsule, whereby the urine may be extravasated into the cellular tissue of the pelvis; 5, wounding the prostatic plexus of veins; 6, tearing the urethra across, and so pushing the bladder off the end of the staff, whilst trying to pass the finger into the bladder. (This accident is due to not making the opening into the urethra large enough, and is most common in children in whom the tissues are readily lacerable); 7, making too small an incision in the prostate so that the parts are bruised or torn in removing the stone, and inflammation is set up; 8, seizing the walls of the bladder by the forceps. *These dangers may be best avoided by observing the following rules*—1, feel the stone with the *staff* before you begin the operation; 2, see that the rectum is empty, and make it contract by introducing the finger; 3, make the external incision free; 4, feel *both* edges of the groove in the staff with the finger, and place the point of the knife *between* them; 5, keep the point of the knife well pressed into the groove of the staff; 6, take care that the finger is pushed into the bladder in *contact* with the naked staff; 7, do not remove the staff till the finger touches the stone.

The difficulties of the operation.—In adults the chief difficulty is to extract the stone; in children to get into the bladder. A. *The difficulty in entering the bladder* depends chiefly on—1, not making the opening into the urethra free enough, and so pushing the finger between the bladder and the rectum; 2, a deep perinæum so that the finger cannot reach the bladder; in such a case a blunt gorget must be substituted for the finger. B. *The difficulties in extracting the stone* are—1, the stone may be too large; 2, it may get behind the prostate; 3, it may be lodged in a pouch in the upper fundus; 4, it may be encysted; 5, it may break or crumble up; 6, it may be so small that it slips from between the blades of the forceps; 7, there may be an enlargement of, or tumour in, the prostate, whereby the urethra is greatly lengthened; 8, there may be some rickety or other deformity of the pelvic bones. When the stone is behind the prostate, curved forceps, with the blades turned down, must be used; when the stone is above the pubes, the blades must be turned upwards, the handle depressed, and the stone pressed down by the hand above the pubes. When too small to be seized, the scoop must be substituted for the forceps. If the stone breaks, the fragments must be removed by aid of the scoop and syringe. If encysted, it may be scratched out with the finger-nail, or freed with a probe-pointed bistoury. If too large to be extracted, the wound should first be slightly enlarged; or this being insufficient, three expedients remain—1, to make an incision in the opposite side of the prostate; 2, to crush the stone; 3, to do the suprapubic operation. The first of these is probably the best. To overcome the difficulty of an enlarged prostate, the blunt gorget must be used and the forceps slid along it. A fibrous tumour in the prostate may be previously shelled out. Where the pelvic outlet is too small to allow of extraction, suprapubic lithotomy must be done.

Causes of death after lithotomy.—1. Diffuse septic inflammation of the cellular tissue of the pelvis due either to infiltration of the urine from too free cutting, or to bruising of the parts in extracting a large stone through a small incision; 2, peritonitis due to the spread of the inflammation to the peritoneum, or a wound of the back of the bladder; 3, shock from too prolonged an operation; 4, exhaustion from primary or secondary hæmorrhage; 5, blood-poisoning, due to the absorption of the products of putrefaction (sapræmia), or to septic phlebitis of the prostatic plexus of veins and pyæmia; 6, cystitis; and 7, suppression of urine. The state of the kidneys is of the most serious import. Where these are healthy as in children, lateral lithotomy is one of the most successful operations in surgery; but in adults in whom grave kidney mischief often exists, it is liable to be followed by one or more of the above complications, especially diffuse pelvic inflammation. Thus, in boys, when death occurs it is generally the result of some one of the accidents liable to occur during the operation; in adults the cause is usually dependent primarily on kidney mischief.

The *after-treatment* is very simple, and consists in little more than keeping the patient clean, and in regulating the secretions and diet. Adults may be placed on a mattress, with a hole opposite the perinæum, for the purpose of letting the urine drain through. During the first few hours it is essential to see that the wound is free. Should the urine not escape from it, it is probably plugged with a clot of blood; the finger must then be passed into the wound, or if a tube has been introduced, this must be cleared by a probe or feather, or by syringing. From the third to the fifth day, in consequence of inflammatory swelling, more or less of the urine is passed by the urethra, but as this swelling subsides, the greater part may again pass by the wound; more, however, is gradually passed by the natural way and less by the wound, as the latter slowly heals. Should secondary hæmorrhage occur, the wound must be plugged; or if this fails to arrest it, perchloride of iron or the actual cautery must be used. For the treatment of the other complications see Cellulitis, Peritonitis, &c.

MEDIAN LITHOTOMY.—Pass a staff, grooved on its convexity, into the bladder, and with the left fore-finger in the rectum, feel for the apex of the prostate. Make an incision with a straight bistoury, with its back towards the rectum, in the median line of the perinæum, beginning about half an inch in front of the anus. Enter the point of the knife into the groove of the staff just in front of the prostate, notching the apex, and cut a little upwards, opening the membraneous portion of the urethra. Withdraw the knife, slightly enlarging the external incision upwards if necessary, and pass a long bulbous probe along the groove of the staff into the bladder. Withdraw the staff, and gently work the forefinger into the bladder along the probe, thus dilating the prostate. Extract the stone in the usual way. The operation is suitable—1. For small stones or foreign bodies; 2. When it is important that there should be but little loss of blood; 3. For the removal of new growths; and 4. For exploring the bladder in doubtful cases of disease. All the cutting is done entirely in the median line where no vessels exist; the deeper parts of the wound are merely dilated, not cut.

SUPRAPUBIC LITHOTOMY consists in opening the bladder between the pubes and the peritoneal fold. It is the method that should be employed for the removal of very large stones, and for certain forms of tumour in the bladder. First, pass a Petersen's india-rubber bag into the rectum, and dilate it with water, and distend the bladder with a weak antiseptic solution; it will then rise well into the abdomen and appear as a prominent tumour, dull to percussion above the pubes. Make an incision in the middle line immediately above the symphysis (Fig. 224b), and having divided on a director the tissues forming the linea alba, expose tho wall of the bladder by gently separating the fatty tissue that lies in front of it with the finger or director, avoiding the peritoneal fold and, if possible, the large veins which ramify in this situation. The bladder having been fixed by inserting a sharp hook into its walls, make an incision into it; introduce the finger to ascertain the size of the stone; enlarge the wound, if necessary, by cutting on a director towards the pubes, and extract the stone by the finger and scoop, or by the forceps. The wound in the bladder may be left open, and the patient placed on his side to ensure an efficient drain and prevent the tissues being infiltrated with urine; or it may, if the bladder and urine are healthy, be closed by suture. Some tie in a full-sized catheter but it is not necessary.

CALCULUS IN THE FEMALE BLADDER is much less common than in the male, a fact in great part due to the shorter and more dilatable urethra in women, to the absence of a prostate and consequent exemption of the female from chronic retention and phosphatic deposits, and perhaps also to the more regular habits of women. The symptoms are similar to those in the male, but are sometimes apt to be accompanied by incontinence of urine. They may at times be simulated by vascular growths in the urethra, by uterine disease, and by hysteria.

Treatment.—1. When the stone is small, rapid dilatation of the urethra with the three-bladed dilator or dressing forceps is the best method of extraction. 2. When of larger sizo (above three-quarters of an inch in children and one inch in adults,) lithotrity with removal of the fragments at one sitting should be done. 3. When too large for removal by dilatation, and the bladder is too contracted to allow of crushing, vaginal lithotomy should be undertaken. 4. When very large, the suprapubic operation is called for.

Vaginal lithotomy.—Place the patient in the lithotomy position, and expose the anterior wall of the vagina by a duck-bill speculum. Seize the stone with a pair of fine long forceps passed through the urethra, and press it on the anterior vaginal wall. Cut through the vaginal wall in the middle line on the stone from behind forwards, stopping short of the cervix uteri posteriorly and the urethra anteriorly. Pass the lithotomy forceps through the wound, and place the stone between their blades with the forceps already grasping it in the bladder and extract it through the wound.

Slow dilatation, and *dilatation with incision* (*urethral lithotomy*) are very liable to be followed by incontinence of urine, especially in the case of female children.

INCONTINENCE OF URINE.—The involuntary escape of urine from the bladder may occur under several conditions. Thus—1. The urine may dribble away as fast as it enters the bladder, in consequence of paralysis of the sphincter vesicæ and inability to close the urinary outlet (*true incontinence*). 2. The urine may be passed involuntarily during sleep without any organic change in the urinary apparatus being discoverable (*nocturnal or active incontinence*, Erichsen). 3. The urine may constantly flow away, in consequence of the bladder being over-distended (as the result of obstruction to the outflow) and capable of holding no more (*retention with incontinence*, or *false incontinence*). This last condition will be described under *Retention of Urine* (p. 736), and the importance of recognizing that it is one of the nature of retention rather than of incontinence cannot be too strongly insisted upon. Whenever, therefore, the patient complains that he is unable to hold his water, or that it is continually dribbling away, an over-distended bladder should be suspected, the abdomen examined for such, and a catheter passed.

True incontinence of urine is very rare. *In males*, it may be due—1, to a peculiar form of enlargement of the middle lobe of the prostate, whereby the urethra is rendered patent instead of being obstructed as is more commonly the case in enlarged prostate; 2, to a like patency of the urethra from the projection of a calculus at the neck of the bladder or from a prostatic calculus; 3, to disease or injury of the spinal cord, implicating the lumbar enlargement, and inducing the bladder to become so contracted and thickened that it cannot hold any urine. *In females* it may be due—1, to over-dilatation of the urethra, as in extracting a calculus from the bladder; 2, to injury of the parts during parturition; and 3, to vesico-vaginal fistula. The *treatment* consists in removing the cause, or if this is impracticable, in rendering the patient's condition as comfortable as possible under the circumstances by a urinary convenience.

Nocturnal or active incontinence generally occurs in children, and must be distinguished from the involuntary passage of urine which is an occasional symptom of thread-worms, calculus, long prepuce, or growth in the bladder. In nocturnal incontinence proper, beyond that the child wets his bed, no sign of disease of any kind is discoverable. *Treatment.*—Presupposing that the absence of thread-worms, calculus, long prepuce and growth in the bladder has been determined, the treatment should consist in tonics, cold baths, and the administration of belladonna in increasing doses till symptoms of belladonna-poisoning appear. The child should lie on his side, not on his back, and be awakened at regular intervals to pass water. I have found the continuous galvanic current of service; one pole should be applied over the urinary centre in the lumbar region, the other to the perinæum. In obstinate cases, Sir Henry Thompson advises the application of a solution of nitrate of silver (10 grains to the ounce) to the neck of the bladder.

HÆMATURIA or bloody urine is generally a symptom of disease or injury of the urinary organs, but may also occur in certain constitutional conditions, as scurvy, purpura, the hæmorrhagic diathesis, and in some fevers. When blood is present in large quantities, the urine will be bright red or coffee or porter coloured; when in smaller quantities, of various shades of brown to which the term "smoky" is applied. Blood may be simulated by urates, indican, bile, or rhubarb or other colouring matter which may have been introduced by impostors. The dark greenish colour of the urine which is produced by the absorption of carbolic acid from a wound, must not be mistaken for blood. Blood may be distinguished by blood-globules being seen under the microscope; or by the ozonic ether test. Add a few drops of tincture of guaiacum to the suspected urine, and then an excess of ozonic ether, shake the mixture and allow it to stand; it will assume a blue colour if blood is present. Albumen will, of course, be detected in the urine if blood is present in quantity.

Source of the blood.—The blood may come from—1, the kidney or ureter; 2, the bladder or prostate; or 3, the urethra. *When from the kidney or ureter* it may be due to (*a*) injury, (*b*) congestion or inflammation, (*c*) Bright's disease, (*d*) the administration of turpentine or the application of a cantharides blister, (*e*) the presence of a parasite, the Bilharzia hæmatobia, in the pelvis of the kidney, (*f*) the impaction or passage of a calculus, (*g*) the passing of a catheter up the urethra, or (*h*) malignant disease. *When from the bladder or prostate* it may be due to (*a*) injury, (*b*) calculus, (*c*) cystitis or prostatitis, or (*d*) villous or malignant growths. *When from the urethra* it may be due to (*a*) injury, (*b*) gonorrhœa or chancre, (*c*) erectile growths, (*d*) calculus, (*e*) rupture of the corpus spongiosum in chordee or sexual intercourse.

Diagnosis.—Blood from the *urethra* comes before the urine, is frequently pure, and may continue flowing between the acts of micturition. From the *bladder or prostate*, it generally comes after the urine, or the urine contains more blood at the end than at the beginning of micturition; it is often clotted from remaining some time in the bladder, and the urine then is of a porter-like colour. From the *kidney* it comes with the urine, with which it is intimately mixed (*smoky urine*). The urine may then contain blood-casts of the renal tubes, or when it comes from the *ureter*, fibrinous casts of the ureter.

The *treatment* resolves itself into remedying where possible the cause (see *Diseases of Kidney*, *Bladder*, &c.). When clots have collected in the bladder, they may be washed out with a stream of water; but when they are decomposing, it may be necessary to open the bladder through the perinæum and remove them.

DISEASES OF THE PROSTATE.

ACUTE PROSTATITIS.—*Causes.*—Generally gonorrhœa, or stricture of the urethra; less frequently cystitis, impacted calculus, and passage of instruments. Occasionally in gouty subjects it appears to occur idiopathically. *Symptoms.*—Micturition is frequent, and attended with pain, especially at the end of the act; there is throbbing and continuous pain in the perinæum and neck of the bladder, and pain during defæcation. When examined by the finger in the rectum, the prostate is found hot, swollen, and painful, and the passage of a catheter causes great pain. The febrile disturbance which accompanies it, is perhaps ushered in by rigors. *Terminations.*—Resolution, abscess, or chronic inflammation. *Treatment.*—Six or more leeches to the perinæum; hot hip-baths; hot poultices to the perinæum; and a purgative at the onset, followed by alkaline medicines. A catheter is only to be passed if there is retention of urine.

Abscess of the prostate is generally preceded by acute inflammation; but chronic abscess may be produced by catheterism in chronic enlargement of the organ. Acute abscess may be suspected, when in the course of acute prostatitis rigors and retention of urine supervene. Fluctuation can at times be felt through the rectum, but the abscess is generally first discovered on passing a catheter for the relief of the retention of urine, when a quantity of pus escapes from the urethra. At times the abscess may burst into the rectum or perinæum. *Treatment.*—Free incision in the middle line of the perinæum to let out the pus. When the pus forms around the prostate instead of in its substance, a *periprostatic* abscess is said to have occurred. The cause, symptoms, and treatment are similar.

Chronic prostatitis generally occurs as a sequel to the acute. The symptoms are similar but of much less intensity; and there is a glairy discharge with, sometimes, a drop or two of blood in it. The urine is cloudy and contains pus and prostatic casts. Nocturnal emissions are frequent. If the inflammation is not relieved cystitis may follow, and the bodily and mental health become seriously impaired. *Treatment.*—Blisters to the perinæum, gentle laxatives, tonics especially iron, change of air or a sea voyage, sea-bathing, a generous diet, and the avoidance of stimulants, horse-exercise and sexual indulgence. The application of nitrate of silver to the prostatic urethra is recommended by some Surgeons when there are nocturnal emissions.

Hypertrophy, or chronic enlargement of the prostate, must be carefully distinguished from the enlargement due to inflammation. It seldom occurs under the age of fifty or sixty, and is a common, though not an invariable, disease of old men. It may be due to hypertrophy of all the tissues forming the prostate; or the glandular, muscular, or fibrous tissue only may be affected, then often forming distinct masses in the substance of the organ. The enlargement may involve the whole prostate, or may be confined to one or other of the lateral lobes or to the so-called middle lobe. The *causes* are not known.

The *effects* of chronic enlargement of the prostate are very serious when the out-flow of urine is impeded, similar changes occurring in the bladder, ureters and kidneys as described under stricture. The bladder behind the enlargement forms a pouch in which some urine may remain, after each act of micturition, unexpelled, and there, mixed with pus and mucus from the walls of the inflamed bladder, undergo decomposition, probably owing to the action of micro-organisms, the urea being converted into carbonate of ammonia, and the phosphates in consequence, precipitated.

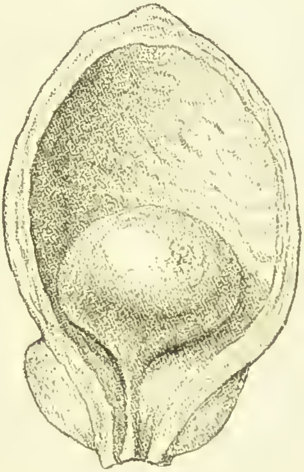


Fig. 260.—Enlargement of the middle lobe of the prostate. (St. Bartholomew's Hospital Museum.)

Symptoms.—Increased frequency of micturition, especially at night; inability to propel the stream to the same distance as formerly, owing to the muscular fibres of the bladder being involved in the disease; and difficulty in commencing the act. Later, the bladder is imperfectly emptied; the retained urine becomes ammoniacal and alkalino in re-action; cystitis is set up, and retention of urine may finally occur.

Diagnosis.—These symptoms may depend upon causes other than enlarged prostate. It is only by a physical examination that the nature of the disease can be accurately made out. On introducing the finger into the rectum the prostate is felt enlarged, unless the middle lobe only is involved. On passing a catheter no obstruction is met with in the urethra; *i.e.*, the catheter passes six or seven inches without meeting with any. and then has to be well depressed before it can be made to enter the bladder. Or an ordinary catheter may not be long enough to enter the bladder, and a prostatic catheter may have to be used.

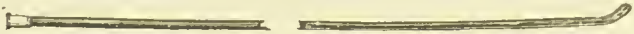


Fig. 261.—Coudée catheter.

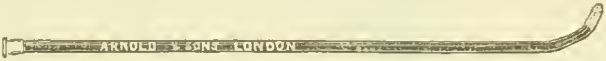


Fig. 262.—Bi-coudée catheter.

Treatment.—In the early stages, as long as the bladder can be completely emptied by the patient's own efforts, the treatment should be directed to improving the general health. If it is found, after urine has been passed, that the bladder still retains some ounces, then catheterization must be commenced. A soft catheter, or, when the middle lobe is enlarged, a coudée or bi-coudée (Figs. 261, 262), should be used at regular intervals, and any cystitis which may exist should be treated as already described. As the disease advances the passage of the catheter may cause a very irritable condition of the bladder. Under such circumstances it becomes a question whether the bladder should be tapped above the pubes, and a cannula kept permanently in; or whether an incision in the middle line of the perinæum should be made to drain the bladder. I prefer the latter method. When retention occurs, and it cannot be relieved by a catheter, the bladder must be tapped above the pubes. Recently the obstruction has been overcome by punching out a piece of the prostate with an instrument invented for the purpose, by boring a new channel with the galvano-cautery, and by opening the bladder above the pubes and removing with the knife or cautery the obstructing portion of the middle lobe.

Sufficient trial, however, has not yet been given to these plans to pronounce an opinion on their merits.

TUBERCLE OF THE PROSTATE may occur in the course of general tuberculosis, or in connection with tubercular disease of the genito-urinary tract. It gives rise to inflammation, and sometimes suppuration, in or about the organ; but its diagnosis will depend on the presence of tubercle in other parts, as the testicle, bladder, vesiculæ seminales, etc.

MALIGNANT DISEASE.—Carcinoma in the old, and sarcoma in the young, may occur in the prostate, but both are rare. Pain, increased frequency in micturition, with passage of blood, often pure, at the end of the act; the presence in the urine of shreds of the growth; the detection in the rectum of a swelling of the prostate of unequal consistency and of rapid growth; enlargement of the lumbar and often also of the inguinal glands; and wasting and cachexia, are the symptoms by which it may be known. The *treatment* can only be palliative; *i.e.*, morphia to subdue pain, astringents to check hæmorrhage, and catheterization or supra-pubic puncture to relieve retention.

PROSTATIC CALCULI are often found in abundance in the prostate of old men in the form of small, brown, seed-like bodies. They are composed of phosphates, with a little carbonate of lime and a large proportion of animal matter, and are believed to be formed by the inspissation of the prostatic secretion, and the subsequent deposit upon it of the earthy salts. Usually they give rise to no *symptoms;* but occasionally one or more encroach upon the urethra, and may attain such a size as to project into the bladder, then causing painful and frequent micturition, involuntary erections and escape of semen, or perhaps, retention or incontinence of urine. A grating sensation, but no true ring, may be elicited on the passage of a sound. At other times the calculi may escape into the bladder and there collecting in considerable numbers give rise to symptoms of stone. Moreover, one or more may be periodically passed by the urethra. *Treatment.*—Unless the symptoms are severe, the calculi are better left alone; but should they attain a large size, or give rise to retention, &c., they should be removed through a median incision in the perinæum. Extraction by the urethral forceps is not likely to succeed; but there is no harm in trying, if all gentleness is used. Where they have collected in the bladder they may be washed out by Bigelow's evacuator.

DISEASES OF THE URETHRA.

SIMPLE URETHRITIS, or inflammation of the urethra of a non-specific character, may be due to injury, catheterization, gout, the irritation of worms, the abuse of alcohol, or contact with leucorrhœal discharges. *Signs.*—Simple inflammation of the urethra is attended with a catarrhal, and at times, by a muco-purulent discharge, and except in the mildest forms, it cannot always, without taking into account the history of the case, be distinguished from gonorrhœa. Like the latter affection it may, though much more rarely, be complicated by cystitis, prostatitis, epididymitis, nephritis, synovitis, and ophthalmia. The *treatment* is similar to that for gonorrhœa.

GONORRHŒA is an infective, and probably specific inflammation, attended with a muco-purulent discharge. In the male it is most common in the urethra, in the female in the vagina and about the vulva; but it may attack any mucous membrane exposed to contagion.

Cause.—In the male it is nearly always due to direct contagion, and in the female it is also commonly contracted in this way; but, in the female, it may possibly be developed *de novo* by want of cleanliness and the decomposition of retained and foul discharges.

Pathology.—Gonorrhœa is by many regarded as a specific and infective inflammation, in that it has a distinct incubative period, is highly contagious, extends along the mucous tracks it attacks, and may secondarily affect the fibrous tissues of the body generally, as in gonorrhœal rheumatism and sclerotitis, and in that the micro-organism (*gonococcus*), found in the discharges after gelatine cultivations to four generations, will set up a similar inflammation in any mucous membrane to which it is applied. In the male, gonorrhœa usually begins in the mucous membrane of the fossa navicularis, and if allowed to run its course, extends backwards along the urethra, and thence may spread to the prostate, bladder, and testicle. In the female, it usually begins about the vulva whence it may extend to the vagina and more rarely to the urethra, bladder, and uterus.

Symptoms.—Gonorrhœa is generally divided into three stages. In the *first stage*, usually lasting from a few days to a week, there is some itching about the external meatus followed by a yellowish-white discharge. In the *second, or acute stage*, there is great pain on urination, a thick yellowish-green discharge, and redness and swelling about the lips of the meatus. In the *third or chronic stage*, which, when prolonged, is known as *gleet*, the discharge becomes thin and watery, and there is no longer pain on urination.

The *treatment* varies according to the stage of the disease. Generally it may be said that at the onset a smart purge should be given, and the bowels subsequently kept slightly relaxed by saline aperients; whilst, throughout its course, stimulants of all kinds must be withheld, demulcent drinks freely taken to dilute the urine, the parts kept scrupulously clean, the testicles worn in a suspensory bandage, and active exercise and exposure to cold and wet avoided. In the *first stage* the so-called abortive treatment is often successful. It consists in the use of astringent injections, and the internal administration of such drugs as copaiva, cubebs, or sandal oil. An excellent plan is that suggested by Mr. Cheyne of passing a bougie composed of iodoform, oil of eucalyptus, and oil of theobroma, into the urethra after the patient has passed water, and allowing it to dissolve there, and subsequently injecting freely with a lotion of sulpho-carbolate of zinc. The bougie should be repeated if necessary. In this way the disease may often be cured in a few days. In the *second stage* most Surgeons recommend a soothing plan of treatment, merely keeping the bowels relaxed, and giving such medicines as hyoscyamus, bicarbonate of potash, &c. Unless, however, the inflammation is very intense, injections of sulpho-carbolate or sulphate of zinc, or of tannic acid, may be safely used and will greatly lesson the duration of the disease. In the *third stage*, astringent injections, combined with the internal use of copaiva, cubebs, or sandal oil are indicated. This stage is often very difficult to cure, and where one remedy or injection fails, another must be tried. The passage of a full-sized bougie is at times of much service. Spring bougies coated with thallin have been lately highly recommended.

COMPLICATIONS OF GONORRHŒA.—Complications of some kind generally occur during an acute attack of gonorrhœa. They may be conveniently classified according as they depend upon:—A. *The local inflammation of the urethra*—1, balanitis; 2, chordee; 3, phimosis;

4, paraphimosis; 5, lacunar and perinæal abscess; 6, retention of urine; 7, warts; 8, stricture; 9, induration of the penis (rare). B. *The extension of the inflammation along the genito-urinary mucous membrane*—1, prostatitis; 2, cystitis; 3, Cowperitis; 4, epididymitis; 5, pyelitis and nephritis (very rare). C. *The extension of the inflammation to the lymphatics of the urethra*—1, lymphangitis; 2, bubo; and, 3, blood-poisoning. D. *The local inoculation of distant mucous membranes with the discharge*—1, gonorrhœal conjunctivitis; 2, nasal catarrh; and, 3, catarrhal inflammation of the rectum. E. *The absorption by the blood-vessels of the septic products*—1, gonorrhœal rheumatism; 2, gonorrhœal sclerotitis; and, 3, septicæmia and pyæmia. Of these complications, some are exceedingly rare, whilst others, as *balanitis*, *chordee*, *phimosis*, *paraphimosis*, *epididymitis*, *bubo*, and *stricture* are common. Most of these complications are described under diseases of the various organs in other parts of the book. Here a short account of the following only will be given.

BALANITIS, or inflammation of the glans penis, often occurs in gonorrhœa. The glans is red and swollen, of a bright red colour, and often excoriated. Cleanliness and astringent lotions are all that is necessary.

CHORDEE or painful erection of the penis, is very common in gonorrhœa. It is generally believed to depend on the inflammatory products in and around the urethra, preventing the corpus spongiosum from becoming distended equally with the corpora cavernosa. Hence, the downward curve that the penis takes when erect. Some, however, attribute it to spasm of the urethral muscles. It occurs chiefly at night-time when the patient is warm in bed, and greatly disturbs his rest. The *treatment* consists in the adminstration of such sedatives as bromide of potassium or of camphor and opium in the form of a pill or suppository, and the local application of cold, or a hot bath before going to bed.

COWPERITIS, or inflammation of Cowper's glands, sometimes occurs, and then usually late in the second stage of gonorrhœa. It may be known by the formation of a painful swelling on one or both sides of the middle line of the perinæum. The swelling, at first hard, subsequently becomes soft and fluctuating as pus forms. It may be distinguished from ordinary perinæal abscess by its one-sided position. *Treatment.*—Warmth to the perinæum, and when suppuration has occurred, a free incision.

LYMPHANGITIS AND BUBO.—The inflamed lymphatic vessels appear as red streaks running along the dorsum of the penis to the inguinal glands, the penis itself, especially the glans, being swollen, turgid, and dusky red in colour. It may terminate in suppuration of the inguinal glands, or even in blood-poisoning. In the ordinary *gonorrhœal bubo*, inflamed lymphatics are not as a rule visible on the penis, and the inflammation which may occur both in and around the gland generally terminates without suppuration. *Treatment.*—Rest, and attention to the bowels, is all that is usually required. If, however, suppuration threatens, hot linseed poultices and fomentations must be applied, and a free incision in a vertical direction made as soon as pus forms.

Stricture of the Urethra.

TRUE, OR ORGANIC STRICTURE OF THE URETHRA is a permanent narrowing of the canal at one or more spots due to disease, injury, or congenital defect. A temporary narrowing of the urethra may also occur from spasm of the muscular tissue surrounding it, or from congestion of its lining membrane, conditions to which the terms *spasmodic* and *congestive* stricture are sometimes applied. Such, however, seldom occur without the co-existence of organic stricture. Obstruction of the urethra by a calculus, an enlarged prostate, or by pressure from without, as from an abscess or fractured pelvic bone, should not be spoken of as stricture.

Cause and formation of stricture.—A stricture is generally the result of chronic inflammation, such as a neglected gonorrhœa or gleet, or more rarely, a simple urethritis. In such cases the mucous and sub-mucous tissue become infiltrated with inflammatory products, which are ultimately organized into fibrous tissue; and this again slowly contracts, narrowing the canal. More rarely a stricture may be caused by the contraction of a cicatrix following laceration or rupture of the urethra, produced by injury inflicted either from within by the careless passage of instruments or the use of too strong injections, or from without by kicks, falls, etc., on the perinæum. Occasionally it may be due to the contraction of the cicatrix following a urethral chancre. In some instances no cause can be ascribed. A few cases are congenital.

Varieties.—Organic strictures have been divided (1) according to their cause, into *idiopathic* and *traumatic;* (2) according to their anatomical appearances, into *linear*, *annular*, *irregular* or *tortuous*, *bridle* or *packthread*, and *tunnelled*, terms which sufficiently explain themselves; (3) according to whether an instrument can or cannot be passed, into *permeable* and *impermeable;* (4) according to their behaviour, into *simple*, *sensitive* or *irritable*, and *contractile* or *recurring*; and (5) according to their structure into *fibrous*, *elastic*, and *cartilaginous*.

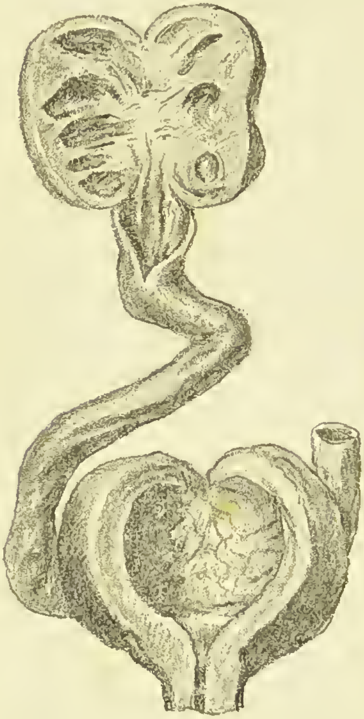


FIG. 263.—The effects of obstruction to the outflow of urine from the bladder on the urinary apparatus.

Situation.—Stricture may occur in any part of the urethra save the prostatic. It is generally said to be most common in the bulbous part of the spongy portion, but Otis and others maintain that it is most often found in the anterior part of the urethra, and that what have been considered deep strictures are only spasmodic conditions consequent upon the reflex irritation of the true stricture in front. In the penile portion of the urethra strictures are usually multiple.

Results.—When a stricture, or indeed any mechanical obstruction to the free flow of urine from the bladder, such as a long prepuce, an enlarged prostate, a narrow meatus, &c., has existed some time, serious structural changes (Fig. 263) occur in the urinary apparatus on the proximal side of the lesion, *i.e.*, in 1, the urethra behind the stricture; 2, the bladder; 3, the ureters; and 4, the kidneys. Thus:—

1. The *urethra* behind the stricture becomes dilated, and ulceration may occur leading to perforation, urinary

abscess and fistula; or rupture may take place suddenly during straining, and be followed by extravasation of urine.

2. The *bladder*, in consequence of its efforts to expel the urine, becomes thickened from hypertrophy of its muscular coat. The mucous membrane may become inflamed and thickened; or owing to the pressure of the urine may be protruded through the muscular fasciculi, forming sacculi, in which stale urine may collect or a calculus form.

3. The *ureters* become dilated, their muscular coats hypertrophied, and their lining membrane sometimes inflamed.

4. The *kidneys* become disorganized, in part from the backward pressure of the retained urine and in part from the spread of inflammation from the bladder up the ureter to the pelvis. See *Diseases of Kidneys*, p. 673.

Symptoms.—A gleety discharge, increased frequency of micturition, and perhaps, some pain in the act, twisting or forking of the stream, or the escape of a few drops of urine after the stream has ceased, are early signs of stricture. Then the stream gets gradually smaller, and is passed with increasing difficulty and straining till finally the urine may only be voided drop by drop, or complete retention may set in. In some instances an attack of retention is the first sign of the disease. In neglected cases the straining may produce piles or prolapse of the rectum; or cystitis may be set up and the urine become ammoniacal and turbid from the presence of pus and mucus; or the bladder may become over-distended, and the urine dribble involuntarily away. This condition of over-flow should be carefully distinguished from incontinence (see p. 707). At first there are usually no constitutional symptoms; but as the obstruction begins to tell on the bladder and kidneys, dyspeptic troubles are developed; the patient loses weight, his countenance becomes anxious, he suffers from chilliness and occasional rigors, from pain in the loins, and later, from feverish attacks and unmistakable signs of kidney mischief. Thus a stricture which in itself, if kept properly dilated, is not a serious disease, becomes so when neglected and chronic bladder and kidney trouble is allowed to be set up. It may then end fatally from an intercurrent attack of acute cystitis or nephritis, or from extravasation of urine and its consequences occurring during an attack of retention.

A *diagnosis* can only be made with certainty by examining the urethra with instruments. First take a No. 8 or 9 black bougie or catheter and if this passes easily try successively larger sizes till the obstruction is met with. If on the other hand it will not pass, try a smaller bougie till one is found that will go into the bladder. If the obstruction to the passage of the bougie is met with within six inches of the meatus, a stricture exists; but if it is further than this the case is one of enlarged prostate. Do not mistake the catching of the end of the bougie in a lacuna or at the triangular ligament, or the spasm that may be present on the first trial for a stricture. Having discovered the stricture, measure the distance from the meatus on the catheter or bougie. Next pass a bulbous stem (Fig. 264) through the stricture, and then withdraw it, noting on the stem where the bulb is caught in the act of withdrawal. This, when compared with the distance noted on the catheter, will indicate the length of the stricture. In the same way the existence of other strictures can be discovered. The calibre of the stricture may be measured by Otis' urethrometer (Fig. 265).

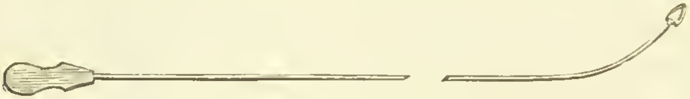


Fig. 264.—Bulbous stem.

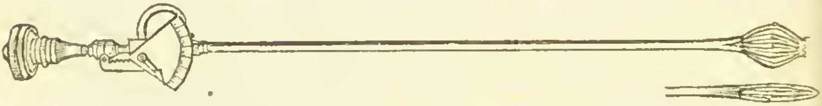


Fig. 265.—Otis' urethrometer.

The method of passing a bougie or catheter can be much better learnt by five minutes' practice than by any written instructions. Here only the general rules for passing such will be given. 1. Carefully examine the instrument to see that it is quite clean, perfectly smooth, not defective in any part, and, in the case of a catheter, that it is pervious, in order to avoid respectively the dangers of septic infection, laceration of the urethral mucous membrane, the breaking off of the end of the catheter in the stricture, and the annoyance of finding that when the catheter has been passed it is choked and urine will not flow through it. 2. Warm and oil the instrument; a cold catheter is unpleasant to the patient and tends to produce spasm; an unoiled catheter does not glide easily along the urethra. 3. Place the patient in the recumbent position if instrumentation is to be practised for the first time lest faintness be produced. In old standing cases, where the urethra is callous, the patient may stand with his back against a wall. 4. Pass the instrument with the greatest gentleness and use no force.

The difficulties that may be met with in passing an instrument are—1. The point may catch in a lacuna or fold of mucous membrane. This is best avoided by keeping the point at first on the floor of the urethra. 2. It may hitch where the urethra passes through the triangular ligament. Should it do so withdraw it a little, and direct the point against the roof of the urethra. 3. It may enter a false passage. This may be known to have occurred by (*a*) the handle being deflected from the middle line, (*b*) by the catheter being felt to be out of the right passage by the finger in the rectum, (*c*) by free bleeding if the false passage is recent, (*d*) by no urine escaping, (*e*) by the point not moving freely as it does when in the bladder. The formation of a false passage may be prevented by using no force; and entering an old one may be avoided by directing the point of the instrument along the wall of the urethra opposite to that in which the opening into the false passage is situated.

The local and constitutional effects that occasionally follow the introduction of instruments.—Among the *local effects* may be mentioned—1, hæmorrhage; 2, false passage; 3, abscess; 4, extravasation of urine, and 5, inflammation of the prostate, testicle or bladder. Among the *constitutional effects*—1, syncope; 2, rigors; 3, urethral fever; 4, suppression of urine; and 5, pyæmia. *Local effects*—1. Hæmorrhage may be due to laceration of the mucous membrane of the urethra by the careless passage of the instrument, or to congestion of the urethra in the neighbourhood of the stricture; in either of these cases the blood may flow on the removal of the catheter, the point of which, moreover, will be blood-stained. Hæmorrhage, however, may come from the kidney, consequent upon reflex congestion due to the irritation of the neck of the bladder by the catheter. The blood will then only appear in the urine after some time has elapsed (see *Hæmaturia*,

p. 708). 2. A false passage may be produced by using too much force, or by applying force in the wrong direction. It is known to have been made by the catheter being felt to slip suddenly onwards, by the handle deviating from the middle line, by the point being felt out of the urethra by the finger in the rectum, and by the patient complaining of severe pain. The catheter should be at once withdrawn and not passed again for a week or more to allow the wound to heal. 3. Abscess, 4. extravasation of urine, and 5. inflammation of the prostate, testicle and bladder require no comment here. *General effects.*—1. Syncope occasionally occurs on the first passage of a catheter. It is best avoided by passing the instrument with the patient in the recumbent posture. 2. The rigors which sometimes follow the first introduction of an instrument appear to depend upon some nervous shock, and may occur where all gentleness has been employed and no local injury whatever has been inflicted. 3. Urethral fever is most frequent in old people and may supervene within a day or two of the first catheterization. It begins with rigors followed by high fever, and usually terminates in a few days with profuse sweating. Occasionally, however, it may end fatally, in which case there is nearly always some chronic kidney disease discovered at the autopsy. Sir Andrew Clark has recently called attention to the possible occurrence of death after the passage of an instrument in old men without any kidney or bladder trouble to account for it. 4. Where suppression of urine has been observed there has always been some pre-existing kidney mischief. 5. Pyæmia is rare, but has occasionally been noted.

The *treatment* of organic stricture resolves itself into restoring the patency of the urethra by causing the absorption and destruction of the inflammatory or cicatricial material producing the obstruction, and subsequently preventing recontraction. The methods employed for restoring the patency of the urethra are 1: *Slow dilatation.* 2. *Rapid dilatation.* 3. *Forcible dilatation or splitting.* 4. *Division of the stricture from within* (internal urethrotomy). 5. *Division of the stricture from without* (external urethrotomy). 6. *Destruction of the stricture by caustics.* 7. *Electrolysis.* Treatment by caustics may be said to have now become obsolete, and will not be further referred to. Of the other methods slow dilatation is no doubt the simplest and safest, and is the one that in the large majority of cases should be used. Where, however, time is an object, or the stricture cannot be dilated by the slow method beyond the size of a No. 4 or 5 catheter, or severe constitutional or local symptoms are set up on each occasion that a catheter is passed, rapid dilatation may be tried. Where again the continual presence of a catheter in the urethra cannot be borne on account of the local irritation which it causes, or the stricture is resilient and rapidly recontracts after it has been fully dilated, internal urethrotomy or electrolysis may be practised, especially if the stricture is in the penile portion of the urethra. Further, when the stricture is of cartilaginous consistency, and will not yield to dilatation, or the perinæum, in addition, is riddled with sinuses, external urethrotomy by Syme's or Wheelhouse's method may be performed. Lastly, when, after persistent attempts, it is found that an instrument cannot be passed through the stricture, electrolysis may be attempted, or external urethrotomy by Wheelhouse's method may be undertaken. When the symptoms are urgent, as from retention or extravasation of urine, other measures may be required. See retention and extravasation of urine, (pp. 736 and 733). Forcible dilatation or splitting does not commend itself to my judgment, and should not in my opinion be employed.

If a catheter will not pass on the first attempt it must not at once be assumed that the stricture is impervious, as it may yield on a future occasion; but gentle and persevering attempts with fine catgut bougies, filiform bougies, French silk bougies, or whalebone bougies, should be made. The patient, presupposing there is no retention, may be asked to pass water, and, whilst the urine is flowing, and the stricture is in consequence dilated by the stream, a bougie one or two sizes smaller than the stream may sometimes be slipped in. If the point of a catheter is firmly grasped indicating that it is in the mouth of the stricture, gentle force may then be used to push it onwards. If in any of these ways a fine bougie can be got in it should not be removed till the patient is compelled to pass water, when a small catheter may be subsequently substituted for it, or a railway catheter slid over the bougie before the latter is removed. If after persevering attempts, even with the patient under the influence of chloroform, success is not attained, the patient should be prepared for a further trial by rest in bed for a week or so, daily hot baths, purgatives, and the administration of opium. When other means have failed, before resorting to a cutting operation electrolysis under some circumstances may be tried.

SLOW OR INTERMITTENT DILATATION is the simplest and safest method of treatment, and does not usually necessitate the patient leaving his ordinary employment. The various catheters and bougies employed are so well known as hardly to require description here. All that need be said is that the soft, flexible, black French bougie, with a bulbous end, is now as a rule generally preferred to a metal or gum-elastic instrument. A bougie or catheter should be passed once or twice a week, beginning with the largest instrument that can be introduced without using force. On the next occasion the same instrument should be again passed and at once withdrawn, and the next size substituted for it, and allowed to remain for a few minutes. In this way the urethra is gradually dilated to its full size. Formerly it was not thought necessary to pass a larger instrument than No. 12, English scale; now, however, few surgeons are satisfied till the dilatation has been carried to the size of No. 14. To prevent recontraction the patient should be taught to pass a catheter for himself, and instructed to do so at first about every month or six weeks, and subsequently two or three times a year, according to the tendency the stricture may show to recontract.

RAPID OR CONTINUOUS DILATATION is very useful: 1. when time is an object; 2. when much difficulty has attended the introduction of an instrument owing to the tightness of the stricture or presence of a false passage; 3. when the passage of an instrument causes great pain, irritation, hæmaturia, or rigors; 4. when gradual dilatation has failed. It consists in tying in a silver catheter for twenty to forty-eight hours, and, on removing it, tying in a size or two larger, and so on till the urethra is fully dilated. The instrument should not fit the stricture too tightly, and its end should not project far into the bladder. It is better, as soon as the stricture begins to yield, to substitute a gum-elastic for a metal instrument. This method necessitates confinement to the couch or bed for ten days or a fortnight, and is not unattended with risk. It frequently causes great pain; and rigors, fever, urethritis, cystitis, epididymitis, and ulceration of the bladder from the irritation of the point of the catheter, may be induced by it. If the catheter merely causes pain, opium may be given, or the urethra be injected with a solution of cocaine; whilst if it produces rigors, fever, cystitis, &c., it must be removed. It is generally believed that the mere presence of the catheter in the stricture causes the absorption of the inflammatory material in the submucous tissue, and that this result is not effected by mechanical stretching, since a catheter that does not fit the stricture tightly answers better than one that does, and causes less irritation. The method of tying in a catheter will be learnt by every student whilst dressing.

FORCIBLE DILATATION, SPLITTING, OR RUPTURE, has been much advocated by Mr. Holt. He passes through the stricture an instrument consisting of two parallel blades with a central stem fixed between them, and then over this stem forces a tube the size of the urethra, thus separating the blades and splitting or rupturing the stricture. A full-sized catheter is then passed. The operation is not unattended with danger, and is more liable to be followed by an early relapse than either rapid dilatation or internal urethrotomy. Indeed internal urethrotomy has now to a great extent taken its place in the treatment of linear, contractile, and penile strictures (the strictures to which it is said to be especially adapted), since the cicatrix following laceration of the tissues is much more prone to contract than that following a clean cut.

INTERNAL URETHROTOMY, or division of the stricture from within the urethra, is an excellent operation, but should only be undertaken when the simpler and safer method of treatment by dilatation has failed. It consists in making a clean longitudinal cut with a guarded knife completely through the stricture, and subsequently in keeping the edges of the wound apart by the passage of a full-sized bougie till the ovoid gap thus left has been filled with new tissue—*the cicatricial splice* of the American Surgeons. The cicatrix following a clean cut shows much less tendency to contract than a cicatrix following a laceration or rupture; hence the superiority of internal urethrotomy over the method of *splitting or rupture.* It is a less severe operation than external urethrotomy, and when a urethrotome can be passed through the stricture should generally be performed in preference to the latter. The cases suitable for it are: 1. Intractable strictures that cannot be dilated beyond the size of a No. 5 or 6 catheter. 2. Strictures which rapidly recontract after dilating instruments are discontinued. 3. Cases in which the passage of instruments is constantly followed by retention of urine, hæmaturia, rigors, urethral fever, or other constitutional symptoms. It is especially applicable to strictures within three or four inches of the meatus. Anæsthesia of the urethra should be induced by injection with a 20 per cent. solution of cocaine. The operation may be done by cutting—1. From before backwards; and 2. From behind forwards. The latter method requires that the stricture should be dilated up to the size of a No. 4 or 5 catheter to enable the sheathed blade of the instrument to be passed through it; the former can be done if the stricture will admit a No. 2 catheter. There are many ways of performing both methods. The following appear to be the best:—

1. *Internal division of the stricture from before backwards.*—If the stricture is sufficiently near the meatus it may be simply divided by a straight blunt-pointed bistoury; otherwise Teevan's urethrotome, which is a modification of

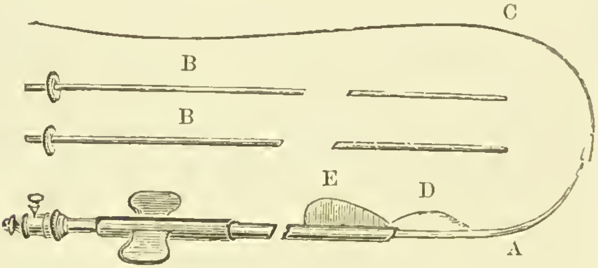


Fig. 266.—Teevan's urethrotome. A, staff; B, stylets; C, olivary bougie; D, knife; E, knife-sheath.

Maisonneuve's, should be used (Fig. 266). It consists of a slender staff A with an open slot running along it to within two inches of its end. Within this staff is fitted a stylet B. The slender olivary bougie C is first wriggled through the stricture into the bladder; the staff A is then screwed on to the bougie and made to follow it, the bougie coiling up in the bladder. When the stylet is withdrawn the urine will escape if the instrument has passed into the bladder and not into a false passage. The knife D, covered by the sheath E, is then placed inside the slot, and the stem of the sheathed knife is pushed down to the stricture. The knife is next protruded to half an inch, and then withdrawn in its sheath, which is pushed forward to see if the stricture is completely divided. If it be not, the process is repeated. Mr. Teevan divides the roof of the urethra to avoid the bulb, and the consequent danger of hæmorrhage from that structure. As soon as the canal is free from one end to the other he passes a full-sized silver catheter to prove that the calibre of the urethra has been restored, and completely empties the bladder. He advises that a catheter should not be left in, and no instrument passed for four days.

2. *Internal division of the stricture from behind forwards.*—(*a.*) Sir Henry Thompson uses a modification of Civiale's urethrotome (Fig. 267). He first dilates the stricture to the size of No. 4 or 5 bougie; then passes the bulb of the urethrotome, which contains the guarded knife, about a third of an inch beyond the stricture; protrudes the knife by a suitable arrangement in the handle, and draws it firmly towards the meatus for about an inch and a half, dividing the stricture along the floor of the urethra, and a little of the healthy mucous membrane at each end of it. He then passes a No. 14 or 16 bougie, and if this is felt to be held at any point, re-introduces the urethrotome, and divides what remains of the stricture.

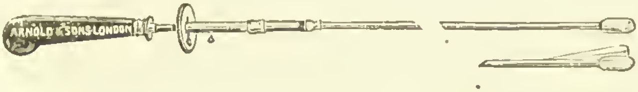


FIG. 267.—Thompson's modification of Civiale's urethrotome.

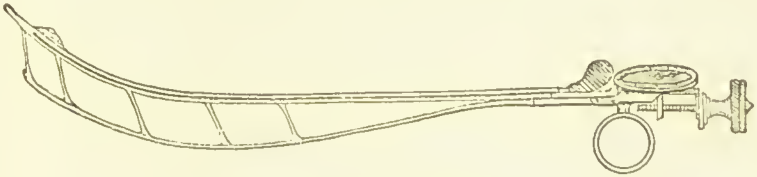


FIG. 268.—Otis' urethrotome.

A No. 12 gum-elastic catheter is then tied in for twenty-four or forty-eight hours. (*b.*) Dr. Otis uses what he calls a dilating urethrotome (Fig. 268). It is introduced beyond the stricture, the screw at the handle is turned, dilating the instrument up to a millimetre or two beyond the normal calibre of the stricture, in order to make the latter completely salient. Then the blade is drawn through the stricture dividing it from behind forwards. Otis claims that when the stricture has been completely divided, recontraction does not occur. This, however, would appear to be contrary to the experience of Surgeons generally, the stricture returning (though less rapidly), as it does after all methods of treatment, if a bougie is not occasionally passed.

For strictures in front of the scrotum, internal urethrotomy is a very successful operation; but in deeper situations it has been followed by abscess, severe hæmorrhage, extravasation of urine, cystitis, nephritis, and pyæmia. It would appear to be attended with a mortality ranging from 1 to 3 per cent.

EXTERNAL URETHROTOMY, or opening the urethra from the perinæum, may be required for two distinct conditions. 1. For certain strictures which, though pervious to instruments, are of an intractable nature. Here the operation known as Syme's should be done. 2. For strictures, through which even after the utmost perseverance an instrument cannot be passed. In these cases the stricture may be divided by Wheelhouse's modification of the old method of perinæal section; or the urethra may be opened by Cock's method, *i.e.*, behind the stricture at the apex of the prostate, and the stricture left undivided in the hope that, relieved from the pressure and irritation of the urine, it may become pervious to instruments.

Syme's method of external urethrotomy or perinæal section.—Syme advised this operation for—1, irritable, and 2, contractile strictures "that are indomitable by the ordinary means of treatment." For such, however, internal urethrotomy is now generally preferred, and Syme's operation reserved for 3, indurated and cartilaginous strictures, complicated by intractable perinæal fistulæ where dilatation has failed. Introduce Syme's shouldered staff (Fig. 269) so that the slender part passes through the stricture into the bladder, and the shoulder

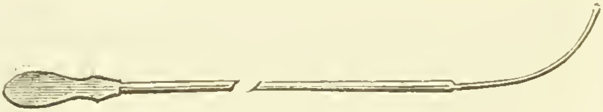


FIG. 269.—Syme's staff.

of the thicker part rests against the face of the stricture. Place the patient in the lithotomy position, and make an incision one inch and a quarter long through the middle line of the perinæum over the stricture. Having felt the staff distinctly in the wound, take it in the left hand, "and guarding the knife with the right forefinger, insert its point into the groove on the bladder side of the stricture, and divide the stricture from behind forward. When completely divided, the thicker part of the staff can be pushed on into the bladder." A full-sized catheter should be tied in for twenty-four hours. The difficulties attending Syme's operation are—1, to be sure that the staff is in the bladder, and not in a false passage; and 2, to pass a catheter afterwards. These are obviated by the modification suggested by Teevan. He uses a catheter-staff with a groove on its convexity, along which the knife can be run to divide the stricture. When introduced, it is known to be in the bladder by the escape of urine on removing the stylet. A bougie is then screwed on to its end, and a gum-elastic railway catheter is passed over the bougie and staff till arrested by the stricture, and is there fixed by a screw. When the stricture is thought to be divided, the catheter is advanced over the staff; and if all is divided, will pass on into the bladder. The catheter-staff can now be withdrawn, and the catheter, if desired, left in the bladder. Syme's operation is very useful, but like other methods is liable to be followed by re-contraction if a bougie is not occasionally passed.

Perinæal section must not be confounded with Syme's operation to which this term is sometimes applied. The older operations of perinæal section were performed by cutting into the urethra either in front of or behind the stricture, and then trying to divide the stricture without a guide. They were the most difficult operations in Surgery. The stricture was often missed altogether and an incision made by its side, and the greatest difficulty was experienced in finding the proximal end of the urethra. Indeed, after a long search the Surgeon had often the mortification of having to send the patient back to bed without having succeeded in reaching the bladder. These difficulties have to a great extent been overcome by Mr. Wheelhouse, who, instead of cutting down upon the end of the staff on the face of the stricture, opens the urethra *half an inch in front* of it, and passes a director through the opening thus made in the urethra into the stricture and divides the latter.

Wheelhouse's modification of perinæal section.—Pass Wheelhouse's staff (Fig. 270), with the groove downwards, to the stricture. Place the patient in the lithotomy position with the pelvis raised so that light may fall into the wound. Make an incision in the middle line of the perinæum, and open the urethra on the groove, (not on the point of the staff) so as to be *half an inch in front* of the stricture. Seize the edges of the healthy urethra on each side by artery forceps, and hold them apart. Withdraw the staff a little, turn it so that the groove looks towards the pubes, and catch up the upper angle of the opened urethra by the hooked end. The urethra is thus held open at three points (Fig. 271). Search for the stricture, and pass a slender probe-pointed director through it into the bladder. Divide the stricture with a probe-pointed bistoury run along the groove in the

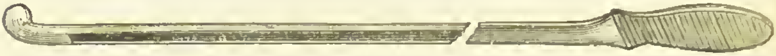


FIG. 270.—Wheelhouse's staff.

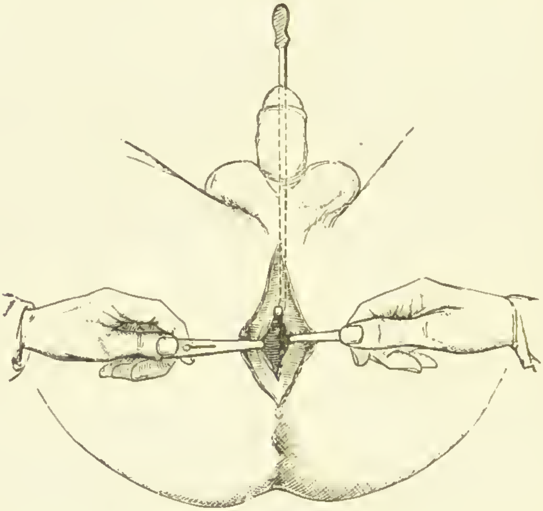


FIG. 271.—Wheelhouse's method of opening urethra. (Bryant's Surgery.)

director. Pass the point of the probe-gorget (Fig. 272) along the groove of the director towards the bladder, dilating the divided stricture. Introduce a gum-elastic catheter from the meatus into the wound, and guide it by the gorget into the bladder. Withdraw the gorget, and retain the catheter in the urethra for three or four days. The catheter should allow a catgut bougie to pass through it to act as a guide in changing the catheter.

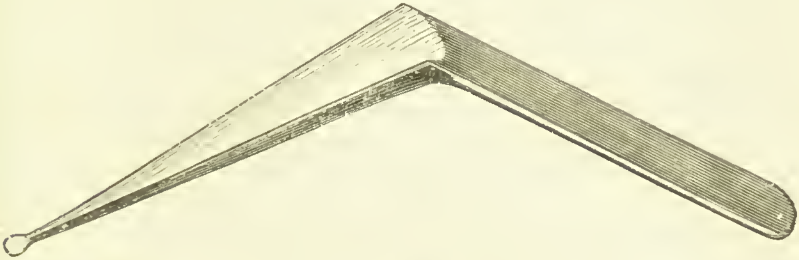


FIG. 272.—Wheelhouse's probe-gorget.

Cock's operation of perinæal section, or tapping the dilated urethra at the apex of the prostate "unassisted by a guide staff." Secure the patient in the lithotomy position. Pass the left forefinger into the rectum, and place its point on the apex of the prostate. Plunge a double-edged scalpel boldly into the median line of the perinæum, and carry it towards the tip of the finger in the rectum. Enlarge the incision by an upward and downward movement of the knife, but do not withdraw it. When the point is felt near the tip of the finger, pass it onwards into the urethra. Withdraw the knife, keep the finger in the rectum, and guide a probe-pointed director into the bladder. Withdraw the finger from the rectum, and pass a cannula along the director into the bladder, and tie it in for a few days. This appears to be a good operation for impervious stricture with fistulæ and much induration of the perinæum, and is held in considerable favour by some of the Guy's Surgeons. For such strictures, however, Wheelhouse's operation is more generally performed.

ELECTROLYSIS has recently been advocated for stricture, and several successful cases in this country have been reported by Dr. Steavenson and Mr. Bruce-Clarke. It consists in passing a catheter-electrode down to the face of the stricture, connecting it with the battery, and applying the other electrode to some other part of the body. It is believed to act by causing some chemical change in the cicatricial tissue, thus leading to its absorption. It has been employed for strictures where an instrument after persistent attempts cannot be passed, and as a substitute in some cases for dilatation. Sufficient time has not elapsed to judge of the results that may be expected from this method of treatment. It is certainly not unattended with danger—extravasation of urine and even death having followed its employment.

Urethral or urinary abscesses may occur at any part of the urethra, but the most common situation is in the perinæum. *Cause.*—They are most often formed in connection with stricture, and are then due to ulceration and local extravasation of urine behind the seat of obstruction. They may also result from injury inflicted either from without or from within, as passing an instrument along the urethra, or the impaction of a calculus; or they may occur during an attack of gonorrhœa from inflammation extending to one of the urethral follicles; or to Cowper's glands. The *signs* of a urethral abscess in the perinæum, its most common situation, are the presence of a hard, brawny, deeply-seated swelling, generally beginning in the middle line just in front of the anus, and as it increases in size, making its way to one or other side of the perinæum in the direction of the groin. At first, while the pus is bound down by the deep fascia, there is no fluctuation, and it is only as it approaches the surface that this sign of abscess can be detected. The abscess is attended with throbbing pain, often with sharp constitutional disturbance, and occasionally with a rigor; it may also cause retention of urine. *Treatment.*—Fluctuation must not be waited for, but a catheter passed down the urethra, and a free incision made in the median line of the perinæum into the swelling. If the abscess is not opened, it may break externally on the perinæum, or it may burrow amongst the tissues and break into the rectum; and if not already in connection with the urethra, as when the abscess forms external to it, it may break into that canal.

Urinary fistulæ are generally the result of urinary abscess in connection with stricture of the urethra. They may also be due to wounds of the urethra, made accidentally, or by surgical operation, or by ulceration following impaction of a calculus. They are commonly divided into three kinds:—1, The *perinæal*; 2, the *scrotal*; and 3, the *penile*.—The perinæal may be single or multiple; the scrotal are nearly always multiple; and the penile single. In long-standing cases the fistulæ may burrow among the tissues of the groin, nates and thighs, and may even open into the rectum.

Treatment.—When due to stricture, the fistulæ will generally readily heal when the stricture is cured and a free natural passage is established for the escape of urine. Should they not do so—1. A *perinæal fistula* when small may be induced to close by passing a soft catheter to prevent the contact of urine whenever the patient micturates, or by inserting into the fistula a hot wire or a probe coated with nitrate of silver. If these means fail, the edges of the fistula may be pared and brought together by sutures. When the parts are indurated and the stricture is of the cartilaginous kind, external urethrotomy and laying open of the fistulæ should be practised. 2. *Scrotal fistulæ* nearly always require freely laying open, and when secondary fistulæ extend to the groin or buttock they should also be treated in this way. 3. *Penile fistulæ* when large, and especially when the result of sloughing consequent upon the impaction of a calculus, usually require a plastic operation.

Extravasation of urine is commonly, though not always the result of stricture, and is then due either to the dilated urethra behind a stricture ulcerating and giving way, or to a lacunar abscess bursting into the urethra. In either case, the urine is forced by the contraction of the bladder into the surrounding cellular tissue. The urethra may give way (1) in front of the anterior layer, (2) between the two layers, and (3) behind the posterior layer of the triangular ligament. In the first and by far the most common situation, it is the bulbous portion of the urethra that gives way. Here the urine is prevented from passing—1, backwards into the pelvis by the anterior layer of the triangular ligament being attached to the ramus of the pubes and ischium and sub-pubic ligament; 2, downwards into the ischio-rectal fossa by the anterior layer of the triangular ligament being continuous around the transverse perinæal muscle with the deep layer of the superficial fascia of the perinæum; 3, laterally on to the thighs by the deep layer of the superficial fascia of the perinæum being attached to the ramus of the pubes and ischium. Hence it passes in the middle line into the cellular tissue of the scrotum and penis, and laterally on to the abdomen, where it is prevented from passing down the thigh by the deep layer of the superficial fascia of the groin (which is continuous with the deep layer of the superficial fascia of the perinæum) being attached along the line of Poupart's ligament. When the *membraneous portion* of the urethra is ruptured, the urine is confined at first between the two layers of the triangular ligament, and if not let out will make its way (1) forwards, through the anterior layer, and take the course as given above, or rarely (2) backwards, through the posterior layer, and then, as when the urethra gives way behind the posterior layer, will make its way around the neck of the bladder, and will be almost inevitably fatal. Wherever the urine spreads, it causes inflammation and sloughing.

Symptoms.—The history of a case of extravasation is not uncommonly as follows. A patient with a tight stricture is straining to pass water, he feels something give way, experiences a sensation of relief, and perhaps owing to the tension being removed by some urine being forced into the cellular tissue, the superadded spasm for a time ceases, and a few ounces of urine are passed through the urethra. In half an hour or so a pricking or burning sensation is felt in the perinæum, soon followed by pain, and by rapidly increasing swelling of the perinæum, scrotum, and penis. If the urine is not let out by timely incisions the swelling extends to the groin, and in some cases has been known to reach as high as the axilla. The skin now appears dusky or purplish-red and œdematous, and gangrene and sloughing of the infiltrated tissues rapidly ensue. The absorption of the septic products gives rise to constitutional disturbance and fever, which though it may at first run high, soon assumes a low typhoid character, and the patient, especially if the subject of chronic kidney disease, frequently sinks into a comatose state and dies. When the extravasation occurs between the two layers of the triangular ligament, it may remain localized, giving rise to a hard circumscribed swelling in the perinæum, which may slowly make its way towards the scrotum; and lastly, when the extravasation occurs behind the posterior layer of the triangular ligament and the urine is extravasated into the pelvic cellular tissue, the symptoms resemble those of extraperitoneal rupture of the bladder.

Treatment.—A catheter should be passed into the bladder, or where this is impossible, down to the stricture, and in either case a free incision in the middle line of the perinæum extending into the urethra made on the catheter. Free incisions through the skin of the scrotum, penis, and groins, in fact wherever the urine has penetrated, should likewise be made to allow of it draining away, and the wounds rendered as far as possible aseptic by the free application of iodoform or other antiseptics. The patient's strength at the same time must be supported by fluid nourishments and stimulants; whilst opium should be given, unless contraindicated on account of kidney disease.

STONE IN THE URETHRA.—A small calculus or fragment of one may become impacted in any part of the urethra, but most frequently in the membraneous portion (Fig. 273), or just within the meatus. When sharp and angular it causes much pain, and when large enough to obstruct the urethra gives rise to retention, and if not soon removed, to ulceration followed by extravasation of urine. *Treatment.*—If far forward, it may often be expelled whilst straining to pass water, by holding the meatus and suddenly letting go; or gentle manipulation, aided, if necessary, by incision of the meatus, may suffice. Extraction by the urethral forceps should next be tried

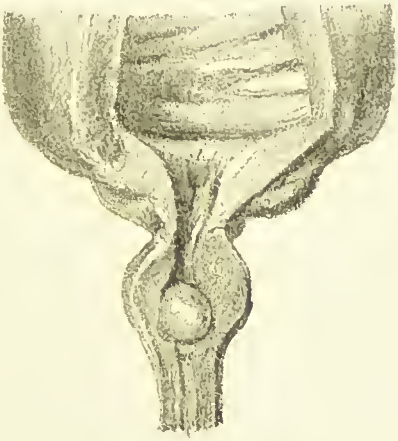


FIG. 273.—Calculus impacted in urethra. (St. Bartholomew's Hospital Museum.)

(Figs. 274 and 275), and, this failing, a free incision over the stone must be made. Thus, if impacted in the membraneous portion, it should be removed through an incision in the middle line of the perinæum; if in the penile portion just in front of the scrotum, it should be pushed back if possible into the membraneous portion and removed through the perinæum, as an incision in the penile portion of the urethra is apt to be followed by fistula, and should, if possible, be avoided. If compelled to incise the penile urethra the incision should be free so as to prevent laceration of the tissues in extracting the stone. The edges of the wound should then be united by suture, and a soft catheter tied in the urethra for a few days till the incision has healed.

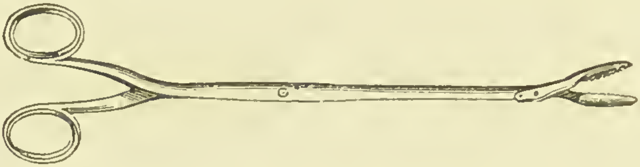


FIG. 274.—Urethral forceps (Arnold's).

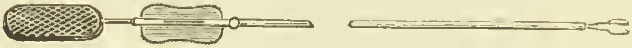


FIG. 275.—Hogan's urethral forceps.

VASCULAR TUMOURS are much more frequent in the female than in the male urethra. In the female, they occur as small florid excrescences usually situated about the entrance of the urethra, often surrounding it like a ring and perhaps extending some distance up it. They give rise to increased frequency of micturition, pain during the act, and intermittent attacks of hæmorrhage, thus somewhat simulating the symptoms of a calculus; but inspection will at once reveal the nature of the affection. *Treatment.*—Ligature, or the application of nitric acid or the thermo-cautery, generally suffices for their cure.

RETENTION OF URINE, or inability to pass water, must be distinguished from suppression of urine in which none is secreted by the kidneys. *Cause.*—Retention may depend upon either (*a*) obstruction to the outflow of urine from the bladder, or (*b*) inability of the bladder to expel its contents consequent upon atony of its muscular coat or paralysis. Retention, therefore, is a symptom of several diseases. 1. In *the old*, it is commonly due to enlarged prostate with superadded congestion, combined with atony of the bladder from over-distension. 2. In *adult men* it may be due to organic stricture with temporary spasm of the unstriped muscular fibres of the urethra, or to congestion of the mucous membrane owing to gonorrhœa, a drinking bout, or cold and wet. 3. In *women* it may be the result of hysteria, the pressure of an enlarged uterus or other pelvic tumour, or the fœtal head in parturition. 4. In *children* it is commonly caused by an impacted calculus or ligature of the penis, and more rarely by phimosis. 5. At *all ages* and in *both sexes* it may be due to reflex spasm after operations on the rectum, shock following any severe injury or operation, tumours in the neck of the bladder or urethra, and to abscesses in any part of the urethra. It may also be due to paralysis consequent upon disease or injury of the brain or spinal cord, and to atony of the muscular coat of the bladder. In the two latter conditions, however, after the bladder has become distended and will hold no more, the excess of urine passively overflows, dribbling constantly away; and this condition of false incontinence must be distinguished from true incontinence in which the urine runs away from the bladder as fast as it is secreted by the kidneys.

Symptoms and signs.—When retention has come on slowly, as from the gradual contraction of an organic stricture, there may be but little local pain and no constitutional disturbance, even although the bladder may be distended by many ounces of urine. Where, however, it is produced suddenly there is usually great pain followed by severe constitutional symptoms—a small and frequent pulse, a dry and brown tongue, and, perhaps, delirium, symptoms probably due to the sudden check to the secretion by the kidneys, and to the stretching of the bladder. The bladder itself, unless greatly hypertrophied and contracted, rises out of the pelvis and may be felt as a distinct tumour, dull to percussion, and at times extending as high as the umbilicus, or in extreme cases even to the ensiform cartilage. The patient, unless drunk, usually complains of inability to pass water. When, however, the bladder has become gradually distended and urine is passively flowing away, he may complain of inability to hold his water and be quite unaware that the bladder is full, and may object to have a catheter passed till the condition has been explained. The presence of a swelling in the abdomen, and the flowing of urine through the catheter immediately after the patient has passed water and believes that he has emptied his bladder, should serve for the diagnosis. In suppression, the bladder is found empty on passing a catheter.

Results of retention.—If the bladder is soon relieved no apparent harm may ensue. If neglected, however, the over-distension may lead to—1, atony of the muscular coat; 2, cystitis; 3, nephritis; 4, rupture of the urethra behind the obstruction; 5, (rarely), rupture of the bladder itself; and, 6, passive overflow of urine, the bladder remaining full.

Treatment.—The distended bladder must be relieved, and if the distension is extreme and the symptoms urgent, at once. The way of doing this will vary according to the cause, and will be considered under the following heads :—

1. *Retention from spasm of the unstriped fibres surrounding* the urethra, sometimes called *spasmodic stricture.* Spasm is rarely, if ever, sufficient, alone, to cause retention. Generally some slight organic narrowing of the urethra is also present. The usual history of retention from spasm is a drinking bout, or exposure to cold or wet in a gouty or rheumatic subject; while on careful questioning, the patient admits that the stream has been noticed to be small or forked, or that a similar attack of retention has previously occurred. If the retention has existed for some time, and there is much pain and considerable distension of the bladder, a full-sized flexible catheter (No. 8 or 9) should be passed, if necessary under chloroform. When, however, the symptoms are not urgent, and an instrument has never been passed, a hot bath and a full dose of tincture of opium will generally suffice. In retention due to spasm following operations, a well-oiled soft rubber catheter should be passed.

When the spasm is associated with a severe organic stricture other means may have to be taken. See *Treatment of Retention from Organic Stricture.*

2. *Retention from congestion of the mucous membrane* of the urethra, sometimes known as *congestive stricture.* Congestion, like spasm, is seldom sufficient of itself to produce retention; and is nearly always associated with at least a

slight organic stricture or with some enlargement of the prostate. It is usually the result of gonorrhœa, or other conditions causing inflammation of the urethra. The treatment is similar to that of retention from spasm.

3. *Retention from hypertrophy of the prostate* only occurs after middle life. It is then generally due to congestion induced by cold, the abuse of alcohol, &c., causing the already existing obstruction to become complete. First, try to pass the French single coudée catheter (Fig. 261). then the double coudée (Fig. 262), and these failing, a gum-elastic catheter with a large curve. Should the point hitch at the middle lobe of the prostate, withdrawing the stylet for half an inch will cause the end to slightly tilt up, and it will then often readily glide into the bladder. If not successful in this way the silver prostatic or the beaked catheter must next be tried, but serious mischief may be done by these instruments unless the greatest gentleness is used. They should never be employed until other forms have failed. If a catheter passes easily it may be withdrawn after the bladder is relieved; but if passed with difficulty it had better be left in, as more harm may be done by having to pass it again than by leaving it *in situ*. When the bladder is greatly distended all the urine should not be drawn off at once, lest syncope be induced. A catheter failing, the retention may be relieved by: 1, puncture above the pubes; 2, puncture through the rectum; and 3, forcing a catheter through the prostate (*tunnelling*). The first method is decidedly the best. The second is seldom applicable, as the enlargement, as a rule, leaves no room between the prostate and the pouch of peritoneum for puncture, which, if attempted, will probably wound the peritoneum. The third method is attended with extreme danger, and is seldom practised at the present day.

4. *Retention from organic stricture.*—The symptoms and diagnosis of stricture have already been described. Here only need be mentioned the treatment to be adopted in cases of retention from this cause. An endeavour should first be made to pass a catheter, if necessary, under an anæsthetic. If this fails, and the symptoms are not urgent, a hot bath and a full dose of tincture of opium may be given, and another trial made in a few hours. Where, however, there are signs of grave kidney mischief, opium must be withheld or given with great caution. Should these means not succeed, or if from the first the symptoms are

urgent, one of the following methods may be resorted to, viz.: 1. Aspiration, or puncture of the bladder above the pubes; 2. Wheelhouse's operation; 3. Puncture of the bladder through the rectum; 4. Cock's operation of opening the urethra behind the stricture through an incision in the perinæum; and 5. Forcing a catheter into the bladder. The last method is highly objectionable, and should on no account be practised. Of the other methods aspiration above the pubes, repeated, if necessary, should the stricture not quickly yield after the spasm has been removed by emptying the bladder and thus reducing the tension, is in my opinion the best. Puncture through the rectum is strongly recommended by some Surgeons; but it is open to the objection that suppuration between the bladder and rectum, extravasation of urine, and a permanent recto-vesical fistula, are liable to follow, to say nothing of the annoyance to the patient from the presence of the cannula in the rectum, and the excoriation of the parts by the urine, which, notwithstanding care, is apt to occur. The vas deferens, moreover, may be injured, and atrophy of the testicle ensue. Cock's operation is difficult to perform, and does not appear to possess any advantage over aspiration or puncture above the pubes. Should the passage of a catheter not be effected after the bladder has been aspirated on several occasions, Wheelhouse's operation should be undertaken. Aspiration, though as a rule attended with excellent results, is not absolutely free from danger. Thus it should not be practised when the urine is unhealthy or the walls of the bladder are thinned and atonied lest a drop or two escape through the puncture and set up septic inflammation and suppuration, which may be followed by extravasation of urine.

5. *Retention from hysteria* should be combated by such moral and physical treatment as is applicable to that disease. A catheter should not be passed if it can be possibly avoided.

6. *Retention from paralysis or atony of the bladder, from abscess or tumour of the urethra or bladder, from impacted calculus, and from ligature of the penis*, is discussed under the heads of Paralysis of the Bladder, Impacted Calculus, &c.

PUNCTURE OF THE BLADDER ABOVE THE PUBES (Fig. 224*b*).—Make a small incision through the skin immediately above the pubes, having first ascertained by percussion that the bladder has risen well out of the pelvis; and thrust Cock's curved trocar and cannula downwards and backwards into the bladder. Withdraw the trocar, secure the cannula *in situ* and pass through it a soft catheter connected with a long rubber tube to carry away the urine. In a few days, when the parts are consolidated, the cannula should be changed. When the bladder is distended, a good inch rises above the pubes uncovered by peritoneum, but when contracted and hypertrophied it may rise but little if at all. Under these latter circumstances the trocar and cannula must be passed close to the pubes for fear of wounding the peritoneum.

Aspiration is performed in a similar way, except that the aspirating needle or trocar is thrust in without any preliminary incision of the skin. If a small aspirating needle or cannula is used there is no danger of extravasation, as on its withdrawal the puncture in the bladder is closed by the contraction of the muscular fibres; and even should a drop or two of urine escape no harm will ensue provided the urine is healthy. It is a most useful emergency operation, and, if necessary, may be repeated on several successive occasions.

PUNCTURE OF THE BLADDER THROUGH THE RECTUM.—Place the patient in the lithotomy position. Pass the left forefinger into the rectum, and place its tip just beyond the back of the prostate. Take Cock's long curved trocar and cannula, with the point of the trocar slightly withdrawn within the cannula. Introduce it through the anus, and guide it by the finger in the rectum to a spot immediately behind the prostate exactly in the middle line. Press the cannula firmly on the fluctuating trigone of the bladder, and plunge the trocar boldly into the bladder, in a direction upwards and forwards towards the umbilicus. Withdraw the trocar, and secure the cannula *in situ* with suitable tapes. Do not plug the cannula, but fix an india-rubber tube on its end and convey this to a vessel beneath the bed.

DISEASES OF THE GENITAL ORGANS.

DISEASES OF THE PENIS.

PARAPHIMOSIS is the strangulation of the glans penis by a tight prepuce which has been drawn back over it, and cannot be replaced. Thus, it is not infrequently met with in boys, from the accidental uncovering of the glans and neglect to draw the prepuce forward again. In adults it is generally due to swelling, caused by gonorrhœa or venereal sores, but it may occasionally occur during coitus. It is attended with great œdema of the glans and prepuce, and if not soon reduced, may lead to ulceration at the line of constriction or even to sloughing of the penis. *Treatment.*—Seize the penis between the first and second fingers of each hand, press the blood and œdema out of the glans with the thumbs, and at the same time push the glans backwards and try to draw the prepuce forwards over it. If this fails, divide with a knife (Fig. 276) the constricting band, which lies just behind the fold of œdematous prepuce at the bottom of the furrow on the dorsum of the penis.

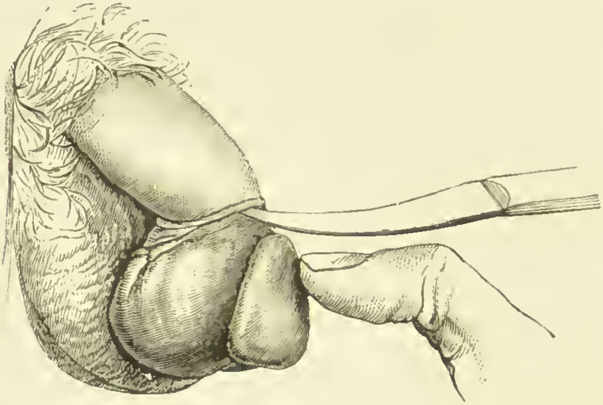


FIG. 276.—Method of dividing the stricture in paraphimosis. (Bryant's Surgery.)

PHIMOSIS is a condition in which the prepuce is elongated, and its orifice contracted, so that it cannot be drawn back over the glans. It may occur as a congenital affection; or it may be acquired, and is then usually due to the cicatricial contraction of the orifice following syphilitic ulceration or repeated attacks of gonorrhœa. The orifice when very small may cause difficulty of micturition or even retention of urine; whilst the straining to pass water may induce prolapse of the rectum, hernia, irritation of the bladder, and symptoms of stone, and if not relieved may produce the harmful effects on the urinary organs described under stricture; or the deposit of the urinary salts beneath the prepuce may lead to the formation of preputial calculi. The inability to uncover the glans may cause pain and difficulty in coitus, and by preserving a mucous membrane-like character to the glans predispose to venereal disease; whilst the secretion which collects beneath the prepuce may, in consequence of the irritation it is apt to set up, induce priapism, habits of masturbation, inflammation sometimes simulating gonorrhœa, adhesion of the glans to the prepuce, or even as age advances the formation of an epithelioma. The *treatment* may be considered under the heads of 1, *circumcision*; 2, *slitting the prepuce*; and 3, *dilatation of the preputial orifice.*

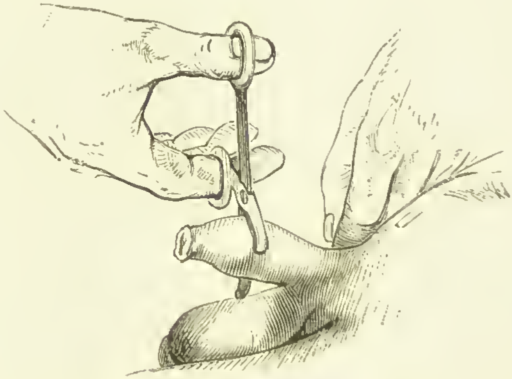


Fig. 277.—Seizing the prepuce preparatory to the operation of circumcision. (Bryant's Surgery.)

1. *Circumcision.*—Lay hold of the prepuce transversely with a pair of polypus forceps, on a level with the corona; let the glans slip back, close the forceps, and shave off all the prepuce in front of them with a clean sweep of the knife. Remove the forceps, slit up the mucous lining of the prepuce in the middle line quite back to the corona, break down any adhesion between the prepuce and glans, wash away the secretion, twist or tie any spurting vessels, and stitch the flaps of mucous membrane to the skin with interrupted horse-hair sutures. Dress with boracic lint or iodoform.

2. *Slitting the prepuce* may be done with scissors or with a curved bistoury, guided by a director introduced between the glans and prepuce. In either case the mucous mem-

brane should be united to the skin-flaps with fine sutures after twisting or tying any bleeding vessels. Care should be taken not to pass the director into the meatus, and to ensure that the mucous membrane is slit quite back to the corona.

3. *Dilatation of the prepuce* may be accomplished in slight cases by a daily endeavour to draw back the contracted prepuce over the glans. It may also be done by the preputial dilator, or by forcible separation of the blades of the dressing forceps, though such means are not often successful.

PRIMARY VENEREAL SORES OR CHANCRES.—Two chief varieties of venereal sore or chancre occur, *the syphilitic* or *infecting*, and the *local contagious* or *non-infecting*. Either of these may be accompanied by sloughing or phagedæna, and are then spoken of as sloughing or phagedænic sores or chancres.

1. *The primary syphilitic chancre* has already been described in the section on syphilis (p. 49).

2. *The local contagious* or *non-infecting sore*, the *soft chancre* or *chancroid* as it is sometimes called to distinguish it from the hard or syphilitic chancre, is a specific form of ulceration probably depending upon a distinct variety of micro-organism. Though the ulcer, like the syphilitic, may occur on any part of the body that is inoculated with the specific virus, it is so much more frequently met with on the genitals that it is described with diseases of these organs. It is not followed by constitutional symptoms.

Signs.—Non-infecting or soft chancres are most frequent at the junction of the glans and prepuce, where they often take the form of a ring of small ulcers around the corona glandis. More rarely they are met with on the mucocutaneous or cutaneous surface of the organ. They usually begin as a pustule or slight excoriation generally within a few days of inoculation, and when fully established, appear as small oval ulcers, with sharply-cut edges and a slightly depressed base covered with a greyish slough, and surrounded by a red areola of inflammation. When irritated, as by the rubbing of the clothes, or the retention of the secretion beneath a long prepuce, they may become indurated; but the induration has not the sharply-defined character of the syphilitic sore. The inguinal glands become enlarged (*bubo*), and matted together into a single mass, often of considerable size, and have a marked tendency to suppurate. The pus taken from them apparently contains the same micro-organism as that of the sore, since when inoculated on the same or another person, a similar sore is produced.

Diagnosis.—The main differences between a non-infecting or soft sore, and an infecting or hard, are the following:—The soft sore is generally unattended with induration; in the hard the induration is well marked; the soft occurs within a few days of inoculation, the hard not till after three to five weeks; in the soft the secretion is abundant and purulent, in the hard scanty, and often consists of little more than epithelial *débris;* the soft can be re-inoculated on the same patient, and hence is frequently multiple; the hard cannot be re-inoculated on the same patient, and hence is single unless, as very rarely happens, the patient is inoculated in two places at the same time. The bubo following the soft sore is single, soft, and very liable to suppurate; that following the hard sore is multiple, hard, and shotty, and very rarely suppurates. A patient, however, may be inoculated with syphilis at the same time that he receives a soft sore. Hence, when the incubative period of syphilis has passed, the soft sore may take on the characters of the hard sore. Till this period is over, therefore, a cautious prognosis as to the probable occurrence of secondary symptoms should be given. It is consequently not uncommon to find a patient with a chancre which presents characters both of the hard and soft sore.

Treatment.—Local treatment only is necessary, and consists in scrupulous cleanliness, protection of the sore from irritation, and the application of blackwash or iodoform. Should the glands become inflamed, rest in the recumbent posture is essential. If suppuration threatens, hot poultices must be applied and a free incision in a vertical direction made as soon as pus has formed. Should any intractable sinuses, as frequently happens, be left after the bubo has suppurated, they should be laid freely open, and allowed to granulate from the bottom.

3. The *sloughing sore* is due to want of cleanliness or the retention of irritating discharges by a long foreskin, and generally occurs in weakly or debilitated subjects. The sore, which is covered with a yellow slough and is surrounded by an angry areola of inflammation, spreads rapidly and is attended with considerable swelling and

œdema of the penis. The general appearances of the ulcer and its appropriate treatment have already been given in the section on *Ulcers* (p. 31).

4. The *phagedænic sore.*—Phagedæna may attack both the hard and soft sore, but is said by Mr. Hutchinson to be a more frequent complication of the former than of the latter. Like sloughing it may be due to want of cleanliness and neglect, or to the irritation of the discharges retained by a long foreskin. It seldom, however, occurs to any serious extent, except in those whose constitutions are broken down by want of food, abuse of alcohol, debauchery, or exhausting disease. For a description of the character and the treatment of this ulcer see p. 31.

EPITHELIOMA of the penis generally begins as a warty growth or as an ulcer on the glans or inner surface of the prepuce. Old age is looked upon as the chief predisposing, and the irritation of retained secretion under a long prepuce as the common exciting cause. The indurated, sinuous and everted edges of the ulcer, the warty base, sanious and foul discharge, rapid growth, advanced age of the patient, and later, the involvement of the inguinal glands, will generally serve to distinguish it from warts or venereal ulcers for which it has been mistaken. If allowed to run its course the whole penis becomes infiltrated with the growth; the lumbar, as well as the inguinal glands, become involved; sloughing and ulceration ensue, and the patient generally dies of exhaustion or hæmorrhage. The internal organs are not usually affected. *Treatment.*—If seen early, the growth alone may be removed. As a rule, however, the penis should be amputated in front of the scrotum unless the glands are much involved or the disease extends backwards beyond this point. In such a case the scrotum may, under certain conditions, be split, the whole penis, with the crura, removed, and the urethra stitched to the perinæum. The inguinal glands if not too extensively diseased should be also removed.

AMPUTATION OF THE PENIS is often performed by one swoop of the knife; when thus done the urethra is liable to retract and cause subsequent trouble in micturition. It is best therefore to divide the corpus spongiosum about half an inch further forward than the corpora cavernosa, and then split the urethra and secure it by suture to the skin. The skin should be drawn well forward before it is divided, as otherwise it is apt to obscure the more retractable stump, and render the securing of the arteries difficult. Too much skin moreover is liable to obstruct the orifice of the urethra. Hæmorrhage during the operation should be restrained by Clover's clamp or by the fingers of an assistant. The two dorsal arteries and the arteries of the corpora cavernosa and of the septum usually require ligature. Amputation by the galvanic éeraseur is strongly advised by some, but is open to the objection that it may be followed by secondary hæmorrhage on the separation of the sloughs.

DISEASES OF THE SCROTUM, SPERMATIC CORD, AND TESTICLE.

Epithelioma of the scrotum, often called sweep's cancer from the frequency with which it occurs in chimney-sweepers owing to the irritation of the soot, generally begins as a dark wart or tubercle which ultimately ulcerates, producing a sore with hard sinuous everted edges, and an irregular warty tuberous base. At times it begins as a chronic eczema. The irritant would appear to be not merely the carbon of the soot, but one or more of the products of the destructive distillation of coal, as the cancer does not occur from soot produced by the burning of wood, and is found amongst workers in coal-tar and its products. The inguinal glands become involved, and occasionally the testicle, but the disease does not, as a rule, affect internal organs. Death is commonly due to the exhaustion produced by the ulceration in the inguinal glands, or hæmorrhage from the opening of a large blood-vessel in the groin. *Treatment.*—Free and early incision with the knife, and removal of the inguinal glands if enlarged and hard. If the testicle is involved it should be excised at the same time. The skin of the part is very lax, and although the testicle may be denuded it rapidly becomes covered in.

Œdema of the scrotum, owing to the laxity of the tissues, is common. It may occur in kidney and heart disease as part of the general dropsy, or it may be caused by inflammation of the neighbouring parts, as the testicle. It is also met with in extravasation of urine, and may occur after an operation for hernia, varicocele, &c.

Erysipelas of the scrotum may be the result of slight injuries, abrasions, &c., or may occur idiopathically. It is attended with great swelling, redness and œdema, and is very liable to terminate in extensive sloughing and gangrene. The same general and local treatment should be adopted as described under *Erysipelas*, with free and early incisions should suppuration threaten.

ECZEMA and PRURIGO of the scrotum require no special mention.

ELEPHANTIASIS SCROTI is an enormously hypertrophied condition of the skin and connective tissue of the scrotum, and probably depends (like a somewhat similar condition known as lymph-scrotum, in which a milky fluid exudes from the skin,) on the presence in the blood of the *filaria sanguinis hominis*. The disease is common in the East, but is seldom met with in this country, and then only in those who have lived in the East. The penis is sometimes affected in a similar manner. *Treatment.*—The hypertrophied mass may be dissected off the testicle and penis, after elevating it for some hours before the operation in order to drain it as much as possible of blood. The base of the mass during the operation should be constricted by an elastic band.

HYDROCELE is a collection of serous fluid in connection with the testicle or spermatic cord. There are several varieties of hydrocele. Thus, the fluid may be contained in the tunica vaginalis (*common or vaginal hydrocele*); and this is further spoken of as *congenital* when the tunica vaginalis communicates, through the non-obliteration of its funicular process, with the general peritoneal cavity, or as *acute* when associated with acute inflammation of the testicle or epididymis. Again, the fluid may be contained in a cyst in connection with the testicle or epididymis (*encysted hydrocele of the testicle or epididymis*), or contained in a cyst formed in connection with the spermatic cord (*encysted hydrocele of the spermatic cord*). The condition described by Pott and Scarpa as *diffuse hydrocele of the spermatic cord*, appears to be a general dropsy of the loose connective tissue of the cord, and is so rare that it may be dismissed without further comment.

COMMON OR VAGINAL HYDROCELE is a collection of serous fluid in the cavity of the tunica vaginalis.

Causes.—Infancy, middle age, heredity, gout, and malaria are said to predispose to it; whilst slight injuries, repeated strains, the presence of loose bodies in the tunica vaginalis, and certain chronic diseases of the testicle are sometimes exciting causes. Often however no apparently efficient cause whatever can be discovered.

Pathology.—By some it is looked upon as a passive dropsy, due to the loss of balance between the secreting and absorbing power of the tunica vaginalis; by others it is believed to be due to chronic inflammation. The fluid is of a pale straw colour, with a specific gravity of 1020 to 1030, and contains a large quantity of albumen. The dilated tunica vaginalis is usually thin; but in long-standing cases it is occasionally greatly thickened, and may be even of cartilaginous consistency. The coverings are the same as those of the testicle, viz., skin, superficial fascia, dartos, and intercolumnar, cremasteric and infundibuliform fasciæ.

Symptoms.—Ordinary hydrocele forms a smooth, tense, elastic or fluctuating swelling in the scrotum, of a pyriform, globular or oval shape, and is frequently slightly constricted at its middle or at its lower or upper part. The chief diagnostic sign is its translucency. If the walls are very thick it may appear opaque when examined for translucency in the usual way by the light of a candle; but I have never met with a hydrocele, however thick its walls, which was not found translucent when a powerful light, as that of an ophthalmoscopic lamp, was used. The cord is free, and there is no impulse on coughing, signs which serve to distinguish it from a hernia. When the hydrocele extends up the funicular portion of the tunica vaginalis into the inguinal canal there may however be a transmitted impulse from the abdominal wall; it might then be mistaken for an irreducible hernia. The dulness on percussion, the history that it began at the bottom of the scrotum, and the translucency, if the light be powerful enough, will distinguish it. The testicle is situated behind and near its lower part, save in exceptional cases, where adhesions have been contracted to the anterior wall, or the testicle has descended retroverted.

The *treatment* may be palliative or radical. *Palliative treatment* consists in tapping the hydrocele with a trocar and cannula, and repeating the operation from time to time as required. Before tapping a hydrocele the situation of the testicle should be made out, lest it be injured by the trocar. This can usually be done by marking the opaque spot whilst examining for translucency, and by the patient's sensation on handling it. If the sac is not very tense the testicle can be felt. Choose a spot for puncture near the bottom of the swelling, free from scrotal veins which can readily be seen through the skin, and having made out the situation of the testicle, grasp the tumour from behind with the palm of the hand so as to make it tense, and plunge the trocar and cannula, held as in Fig. 278, sharply into the sac to ensure perforating the wall. The trocar should be directed at first backwards, and then immediately turned upwards to avoid wounding the testicle. Having withdrawn the fluid, remove the cannula, and apply a small pad of lint or strapping.

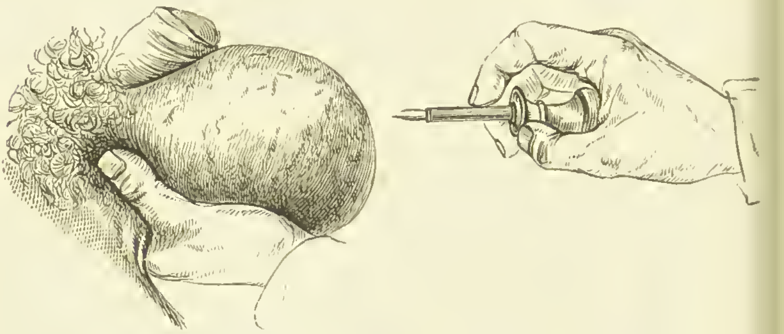


FIG. 278.—Tapping a hydrocele. (Bryant's Surgery.)

The *radical cure* is commonly effected by injecting tincture of iodine into the sac through the cannula after having withdrawn the fluid. The quantity injected is usually about two drachms. If ten drops of a 3% solution of cocaine is injected before the iodine no pain is felt. The iodine sets up some slight amount of inflammation, and generally cures by restoring the balance between the secreting and absorbing power of the tunica vaginalis, or occasionally by causing adhesions between the two layers of the tunica vaginalis. Should the injection fail, it may be repeated; or the tunica vaginalis may be laid open, a portion cut away, and the remainder united by suture and drained. But even this treatment cannot always be depended on for curing the hydrocele. The only absolutely certain method is to lay open the sac and allow it to granulate up from the bottom.

The hydroceles so frequently seen in young children generally undergo a spontaneous cure, and nothing beyond a discutient lotion is usually necessary. Should the hydrocele prove intractable, however, it may be punctured with a fine trocar and cannula, and, if necessary, afterwards injected with a weak solution of iodine.

CONGENITAL HYDROCELE is a collection of fluid in the sac of the tunica vaginalis, the funicular process of which through an arrest of development has remained unobliterated. The fluid, therefore, unless the aperture of communication is very small, can be readily pressed back into the abdominal cavity, and an expansile impulse is given to it on coughing or crying. In this respect it resembles a hernia; but its translucency and the fact that the fluid goes back slowly and without the sudden slip or gurgle as is the case in a hernia, should serve to distinguish it. It should not be forgotten that a piece of omentum or intestine may descend into the sac of the hydrocele. At times, the aperture of communication between the funicular process and the general peritoneal cavity is closed, and though the hydrocele still extends more or less up the inguinal canal, the fluid cannot be pressed back into the abdominal cavity. To this condition the name of *infantile hydrocele* has been given.

Treatment.—A truss should be applied over the inguinal canal to cause obliteration of the funicular portion of the tunica vaginalis, and to prevent the descent of a hernia, and subsequently the hydrocele may be treated in the ordinary way. As a rule, however, when the obliteration of the funicular portion has been accomplished, the hydrocele undergoes a spontaneous cure.

ENCYSTED HYDROCELE OF THE TESTICLE.—This term is applied to a cyst or cysts formed in connection with the testicle or epididymis, but having no communication with the cavity of the tunica vaginalis. Cysts in connection with the testicle itself are very rare, and require no further description here. Encysted hydroceles of the epididymis, however, though still rare, are more often met with, and may be divided into (1) the *subserous cysts*, which are of no clinical importance, and (2) the *spermatic cysts*. The latter are thin-walled, membraneous cysts, and are lined with tesselated epithelium, and contain a watery, slightly opalescent or milky fluid, in which there is often an abundance of spermatozoa. The presence of the spermatozoa may be due to the rupture into the cyst of one of the seminal ducts; or to the cyst being developed in connection with a seminal duct. The origin of these cysts is doubtful. They are generally believed, however, to be developed from some of the fœtal remains (Wolffian body, Müllerian duct, &c.) so abundant in the situation of the epididymis.

Signs.—They appear as tense, fluctuating, translucent, moveable, globular, smooth or lobulated swellings, without impulse on cough, and situated immediately above or behind the testicle. The cord is generally free. They are often combined with an ordinary hydrocele.

The *treatment* is like that of ordinary hydrocele.

ENCYSTED HYDROCELE OF THE SPERMATIC CORD is a collection of serous fluid in an unobliterated portion of the funicular process of the tunica vaginalis. The fluid is similar to that of an ordinary hydrocele. The coverings of the cyst are those of the funicular process, viz., the skin, and the superficial, intercolumnar, cremasteric, and infundibuliform fasciæ; the vas with the arteries and veins are behind it.

Signs.—An encysted hydrocele of the cord appears as a well-defined, tense, oval or globular, fluctuating, freely moveable swelling in the course of the spermatic cord. It is unconnected with the testicle below, and cannot be reduced into the abdomen above although it may be pushed back some distance up the inguinal canal. It is translucent, and gives no impulse on coughing. But when high up in the inguinal canal, it may be difficult to distinguish from a small irreducible hernia, as an impulse is communicated to it from the abdominal walls, and it may be impracticable to detect its translucency. A cautious puncture, with a grooved needle, may then be necessary to diagnose it.

Treatment.—Painting with tincture of iodine may first be tried. This failing, the cyst should be punctured with a small trocar and cannula. Should it refill, it may be injected with iodine, like an ordinary hydrocele, or it may be laid open by an antiseptic incision. But before undertaking its radical cure, you must well assure yourself that there is no communication with the peritoneum. This may usually be done by noting that no decrease in size takes place on applying steady pressure for some little time.

VARICOCELE is a dilated and varicose condition of the spermatic plexus of veins.

The *causes* of varicocele are not really known. It has been attributed to an extra lax state of the parts, induced by debility and general want of tone; congestion from too early or continual excitement of the sexual organs; occupations involving long standing; and to certain anatomical peculiarities (all of which, however, are present in every healthy male), such as the great length of the spermatic veins, the dependent position of the testicle, the plexiform arrangement of the veins in the scrotum, &c. But it often occurs in men in good health, and in whom the parts are not lax. The reasons given for its much greater frequency on the left than on the right side are—1, that the left vein is longer than the right; 2, that an obstacle is offered to the outlet of the left vein by its opening at right angles into the renal vein; 3, that the blood pressure is less in the vena cava than in the renal vein; 4, that the left vein is crossed by the sigmoid flexure, and is hence liable to be pressed upon by fæcal accumulations. Mr. W. G. Spencer, who has recently worked at this subject, believes that the presence of the large veins is due to a congenital variation from the normal process of development, whereby many of the veins of the Wolffian body (from which the spermatic veins are formed) remain unobliterated, and capable of being dilated by anything obstructing the return of venous blood from the testicle. More of these veins, he says, are normally obliterated on the right than on the left side.

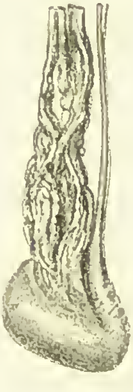


FIG. 279.—Varicocele. (St. Bartholomew's Hospital Museum.)

Symptoms and diagnosis.—There may be merely a sense of weight and fulness in the scrotum, or dragging or even severe pain worse after the day's work, but relieved by recumbency. The symptoms, however, are often more mental than physical, the patient fearing impotence or sterility, and sometimes becoming hypochondriacal in consequence. The varicose veins, which may sometimes be seen through the skin of the scrotum, form a soft, irregular, opaque, knotted, pyriform mass, in which there is a distinct expansile thrill or impulse on cough. The swelling is confined to the scrotum, and, although it may be reduced on the patient lying down, it does not go back with a gurgle or slip like a hernia, and gradually returns when the patient rises, notwithstanding that the finger is placed over the external abdominal ring. The testicle, though perhaps, as a rule, a little smaller than natural, is seldom much atrophied.

The *treatment* may be either palliative or radical.

The *palliative treatment* consists in cold sponging, the use of shower-baths, healthy exercise, regulation of the bowels, and the administration when indicated of ferruginous tonics; whilst the mental anxiety of the patient should be relieved by the assurance that atrophy or impotence need not be feared. *Locally*, a suspensory bandage should be worn, or the veins braced up by drawing the lower part of the scrotum through a *Wormald's ring.*

The *radical treatment* should only be undertaken (1) when the varicocele is large or causes much pain; (2) when it acts as a bar to the entering of the public services; or (3) when it appears to be inducing atrophy of the testicle. Whether it should or should not be undertaken for the cure of mental distress, must be left to the judgment of the surgeon in each individual case. The operations for the radical cure, which have for their object the obliteration of the enlarged veins, are many. Here only is described the method by subcutaneous ligature and division. Separate the vas, which can always be felt as a rounded cord, from the veins; pass with a nævus needle a thread of catgut or kangaroo-tail tendon between the veins and the vas, and then back again between the veins and the skin, and tie the veins, allowing the knot to slip through the puncture in the skin. Repeat the procedure three quarters of an inch above, and then divide the veins between the ligatures with a tenotomy knife. The spermatic arteries escape injury as they slip away with the vas, to which they are attached.

Other methods consist in the subcutaneous division of the veins with the galvano-cautery wire; excision of the veins; compression of the veins by hair-lip pins and figure-of-8 sutures; division of the veins with the elastic ligature, &c. The method described above can be recommended as safe, painless, efficient, easy of performance, and as necessitating the minimum amount of rest subsequent to its performance.

TUMOURS OF THE SPERMATIC CORD, though occasionally met with, are too rare to require any description in a work of this character.

HÆMATOCELE OR COMMON HÆMATOCELE is an effusion of blood into the cavity of the tunica vaginalis. Blood may also be effused into an encysted hydrocele of the testis, epididymis or cord, into the substance of the testicle itself, or into the tissue of the scrotum; and to such the terms hæmatocele of the testis, hæmatocele of the cord, &c., have been applied. All of these conditions, however, are too rare to admit of any description here.

Causes.—An ordinary hæmatocele may be due to a blow on the testicle, or a strain in lifting heavy weights, or a like injury to a hydrocele; to the puncture of the testicle or blood-vessel in tapping a hydrocele; or to the giving way of a weakened or varicose vessel in consequence of the alteration in tension on removal of the hydrocele-fluid by tapping. At times, however, it may occur spontaneously, and is then probably due to some atheromatous or other change in the vessels or chronic inflammation of the tunica vaginalis.

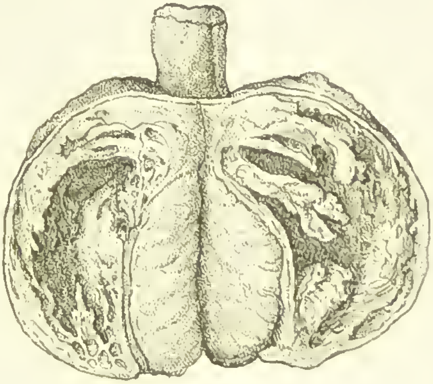


Fig. 280.—Hæmatocele. (St. Bartholomew's Hospital Museum.)

Pathology.—The effused blood may be absorbed, or it may clot and be deposited on the walls of the sac, giving the hæmatocele the appearance of an aneurism (Fig. 280); or the central portions of the clot may break down into a chocolate-coloured fluid, which under the microscope is seen to consist of disintegrating blood corpuscles, hæmatine and cholesterine crystals. At times suppuration may take place, the fluid in the sac then consisting of a mixture of broken-down blood and pus. Calcification of the walls in old-standing cases may occur.

Signs and diagnosis.—Hæmatocele comes on suddenly, appearing as a smooth, tense, or semi-fluctuating, oval or globular, non-translucent swelling in the scrotum. At first there may be considerable pain in the testicle and ecchymosis of the scrotum; but later, neither as a rule will be present. Testicular sensation is generally discovered behind the swelling. The freedom of the cord and absence of impulse on coughing should at once serve to diagnose it from a hernia, and its non-translucency from a hydrocele. But from malignant or other growths it is often difficult to distinguish it; and, indeed, in some cases it is only after puncture with a grooved needle or even after an exploratory incision, that this can be done. The history of its sudden onset, its shape, the absence of the varying consistency noted in malignant disease, the non-involvement of the glands or of the cord, and the presence of testicular sensation posteriorly, should help in the diagnosis. On puncture a chocolate-coloured fluid escapes in the one case; arterial blood, or nothing at all, in the other.

Treatment.—When the hæmatocele is recent, rest in bed, the application of cold or of evaporating lotions, and the elevation of the part on a pillow, may lead to the absorption of the blood. If this fails, the blood may be withdrawn with a trocar and cannula. When such is done, however, the sac in my experience generally refills, and I believe time is gained in the end by at once making a free incision into the sac, turning out the clots, securing any bleeding vessel that may be seen, and allowing the wound to heal by granulations. In long-standing cases, and especially when the walls are much thickened, this treatment is clearly indicated; but if, on laying the sac open, the walls are found of cartilaginous consistency, perhaps calcified, and the patient is old or broken down in constitution, excision of the testicle is then called for, as otherwise long-continued suppuration, which may terminate in exhaustion and death, may ensue. Where suppuration has occurred, a free incision should, under any circumstances, at once be made.

ACUTE INFLAMMATION OF THE TESTICLE is generally spoken of as *orchitis* or *epididymitis* according as the body or the epididymis is primarily or chiefly affected.

Causes.—Gonorrhœa is the most frequent cause; but injury of the testicle, or irritation of the prostatic urethra, as from the tying in of a catheter, or from the impaction of a calculus or fragment of a calculus, are not uncommon causes. Orchitis sometimes occurs during an attack of mumps, and is then said to be due to metastasis. It has also been attributed to the use of strong injections for the cure of gonorrhœa. How inflammation of the testicle is induced by the irritation of the urethra is a disputed question. It is variously taught, however, that it is due to—1, inflammation spreading along the vas; 2, reflex irritation; and 3, metastasis.

Pathology.—The walls of the tubules and the intertubular connective tissue become infiltrated with inflammatory products, and the tubules filled with desquamated epithelium. Resolution usually occurs, leaving the testicle little or not at all impaired either in structure or function. Suppuration, however, is occasionally induced; and when the epididymis is chiefly involved, the inflammatory material, in place of being absorbed, may be converted into fibrous tissue, which, subsequently contracting, may cause obstruction of the tubules of the epididymis. Such may be known to have occurred by the presence of a small hard lump in the region of the globus minor or major. An effusion of fluid into the tunica vaginalis (*acute hydrocele*) is very common, but more so in epididymitis than in orchitis, because the visceral layer of the tunica vaginalis is in contact with the inflamed tissue in the former case, but is separated from it by the thick tunica albuginea in the latter.

Signs.—In a well-marked case there is intense pain in the testicle, with a dragging or aching pain in the groin and along the course of the cord. The testicle is swollen, and exquisitely tender on handling; the cord feels slightly thickened; and the skin of the scrotum is œdematous and of a dusky-red colour. When the inflammation falls on the epididymis, the pain and swelling will be chiefly confined to the upper and back part of the testicle, the region of the epididymis, and fluid will often be detected in the tunica vaginalis. The discharge, if the inflammation of the testicle occurs during an attack of gonorrhœa, generally ceases or becomes less when the inflammation is at its height. The local signs are often accompanied by sharp febrile disturbance, raised temperature, furred tongue, nausea or even vomiting, and constipated bowels.

Treatment.—When the attack is acute, rest in bed with the testicle supported on a pillow is necessary. Hot fomentations, and in the intervals hot linseed-meal poultices, applied to the testicle and groin, give the most relief. Internally a brisk purge should be given at the onset, followed by saline laxatives and small doses of antimony. If the pain is very severe, opium may be given; or a vein of the scrotum opened; or the tunica vaginalis or testicle punctured to relieve tension either with a needle in several places or with a tenotomy knife. If suppuration occurs, a free incision should be made to let out the pus. In subacute attacks, where the patient is unable to leave his work, a suspensory bandage should be worn.

CHRONIC INFLAMMATION of the testicle may be a sequel to the acute disease; or it may begin as a chronic or subacute affection, and like the acute form may involve either the body of the testicle or the epididymis, or both. The two chief causes of chronic inflammation are undoubtedly syphilis and tubercle; but it may occur quite independently of either of these affections, and should then, for the sake of distinction, be called *simple chronic orchitis* or *epididymitis*. The *syphilitic* and *tubercular* forms are described separately under those heads.

Signs.—The testicle appears enlarged, smooth, laterally compressed, egg-shaped, hard, heavy, and painful on pressure; the testicular sensation is not lost; the vas is but slightly thickened; the skin is non-adherent, and the epididymis (except when the disease is limited to that part) is not distinguishable from the body of the organ. In chronic epididymitis an indurated, painful, and tender lump is felt in the situation of the globus minor or major.

Treatment.—Mercury or iodide of potassium should be given internally, and strapping applied to the enlarged organ when the body is chiefly affected. In chronic epididymitis, in addition to internal remedies, inunction with mercurial ointment may be of service.

TUBERCULAR DISEASE OF THE TESTIS, also known as strumous orchitis, or strumous sarcocele, is variously believed to depend upon the presence of the tubercle bacillus, or upon a chronic inflammation in a strumous subject, and to begin either as a tubercular affection in the intertubular connective tissue, or as a catarrhal inflammation in the interior of the tubules.

Pathology.—Opportunities for examining the testicle in the early stages of the disease are not common. Hence, the uncertainty as to the origin and exact nature of the inflammation. Typical nodules of tubercle, however, have been found, and tubercle bacilli have been demonstrated either in sections of the organ or, when few in number, after cultivation. The disease generally begins in the epididymis, and thence may spread to the body of the organ. It may also extend up the vas to the vesiculæ seminales and prostate, and thence to the bladder, and even to the ureters and kidneys. In some cases the testicle appears to be the starting point of a general tuberculosis; in others, merely to be involved in common with other organs in the general disease. In many instances, however, the disease may remain localized to the testicle, and no other manifestation of tubercle occur in the body. The inflammatory products infiltrating the epididymis and testicle, have a great tendency to undergo caseation, forming the yellow masses of cheesy-looking material so characteristic of the disease (Fig. 281).

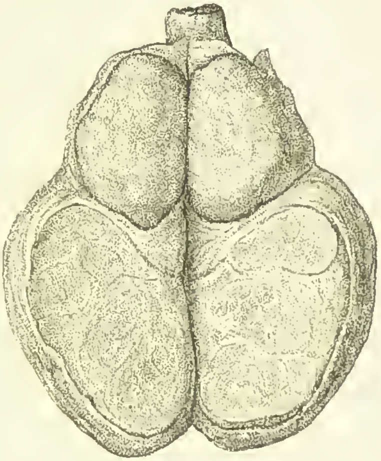


Fig. 281.—Tubercle of the testicle.
(St. Bartholomew's Hospital Museum.)

Signs.—The disease usually begins very insidiously and with little pain. The epididymis, especially the head, and later the body of the testicle, are found enlarged. The testicle is usually but slightly tender on handling, and the testicular sensation is not lost; a hydrocele may be present, or part of the tunica vaginalis may be obliterated. Subsequently the cord, especially the vas, becomes thickened and the skin adherent; whilst still later, the skin may give way and a fungus composed of the infiltrated tubules protrude, or a discharging sinus be produced. The vesiculæ seminales or prostate may now be felt enlarged on examining by the rectum, and bladder or urinary troubles may set in; whilst symptoms of tubercle in the lung, larynx or other organs may supervene, and the patient succumb to tubercular disease. At other times no constitutional signs manifest themselves, and the patient may completely recover.

Diagnosis.—From syphilitic orchitis it may generally be distinguished by the enlargement of the epididymis, thickening of the cord, adhesion of the skin, enlargement of the vesiculæ seminales, and concomitant signs of struma or tubercle elsewhere.

Treatment.—In the early stages, before the vas or vesiculæ seminales have become involved, some Surgeons advise the removal of the organ for the purpose of preventing, if possible, general dissemination of the disease, and where both testicles are affected, even the removal of both. Others, however, rely on constitutional treatment, and only advise the removal of the testicle when it has become destroyed by the disease. Should the vesiculæ seminales be found affected in the early stages, or signs of tubercle be discovered in other parts, the testicle should of course on no account be excised. The *constitutional treatment* is that already described under Struma and Tubercle (p. 47). The *local treatment* consists in suspension of the organ, avoidance of horse or other violent exercise, and recumbency during an exacerbation of the inflammation. Should the tubercle soften and suppuration occur, the abscess must be opened and the wound dressed with iodoform or other antiseptic; if intractable sinuses remain, they should be scraped with a Volkmann's spoon. If a fungus forms it will frequently recede under rest in bed, cleanliness, and the application of a stimulating ointment or of iodoform. Should the testicle become completely disorganized it had better be excised.

SYPHILITIC DISEASE OF THE TESTICLE occurs during the late secondary and the tertiary stages of syphilis. *Pathology.*—The lesion in the earlier stages of syphilis usually takes the form of a small-cell-infiltration of the intertubular connective tissue; in the later stages, of distinct gummatous masses, resembling gummata in other situations. The body of the testicle alone is usually affected, and though, in some instances *syphilitic epididymitis* is met with, the cord and epididymis generally escape. In the secondary stage both testicles may be implicated, either simultaneously, or, as more often happens, one after the other, the disease here, as in other secondary affections, manifesting its tendency to be symmetrical. Under appropriate treatment the small-cell-infiltration may be completely absorbed, leaving the testicle apparently little, if at all, affected; or it may undergo fibroid changes, and the subsequent shrinking of the fibrous tissue produce more or less atrophy of the organ. But it seldom breaks down and suppurates as the gummatous form in patients with undermined constitutions is apt to do. In the tertiary affection one testicle only is, as a rule, involved, the asymmetrical character of tertiary syphilis being thus borne out. The gummatous masses may clear up under treatment, but where the constitution is impaired they are liable to break down and suppurate. The typical appearance of a gummatous testicle on section is seen in Fig. 282. The organ is occupied by large yellowish-white nodules of a tough, fibrous, non-vascular material; two of the smaller gummata are distinct; the remainder have coalesced into a mass which occupies the anterior part of the organ. A loose fibroid tissue, which is very vascular and of a pink colour, surrounds and separates the nodules.

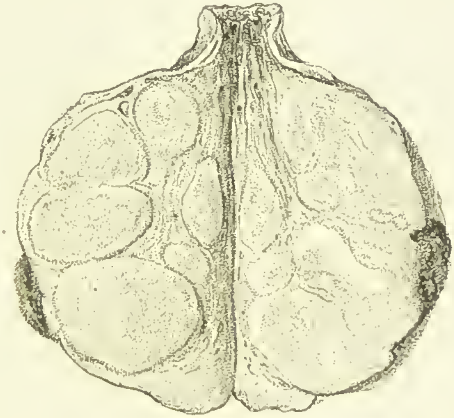


FIG. 282.—Syphilitic testicle. Gummatous variety. (St. Bartholomew's Hospital Museum.)

Signs.—Syphilitic disease is very insidious and painless in its onset, the testicle often attaining some size before the patient's attention is directed to it. The testicle is enlarged, very hard, not tender on handling, and, as a rule, absolutely painless; the testicular sensation is completely lost; the skin is not involved, but appears natural, and is freely moveable over the swelling. The signs, however, vary somewhat according to the stage of syphilis at which the testicle is affected. Thus, in the secondary stages, the testicle is smooth, oval, and often laterally compressed; in the tertiary, nodular, and irregular, and the tunica vaginalis frequently contains fluid (*vaginal hydrocele*). In the secondary, usually both testicles are affected; in the tertiary, often only one. In the tertiary, moreover, the gummata, in neglected cases, or where the constitution is undermined, may break down, the skin become involved in the inflammation and give way, and a sore, having the characters of a tertiary syphilitic ulcer, result. More rarely a fungus may protrude. The characters of the secondary and tertiary disease, however, often merge into each other. A syphilitic testicle may have to be diagnosed from simple orchitis and from tubercular disease. The freedom of the cord and epididymis, the absence of all pain and tenderness on handling, the loss of testicular sensation, the hardness of the organ, the non-implication of the skin, the presence of a vaginal hydrocele, the history of syphilis, the fact that the patient has not had gonorrhœa or a previous attack of acute orchitis, nor received an injury to the testicle, and the absence of signs of tubercle in other organs, point to the disease being of a syphilitic origin. It must not be forgotten, however, that syphilis may occur in a strumous subject; and that the characters of the two affections may then be more or less combined.

Treatment.—The earlier the testicle is affected in the course of constitutional syphilis the more marked will be the effect of mercury; the later, of iodide of potassium. Often the best results are obtained from the two drugs combined. Locally, the testicle may be merely suspended; or it may be strapped in the earlier stages with advantage. Any fluid in the tunica vaginalis will commonly be absorbed during the treatment, though sometimes tapping may be required. Should the skin give way, and an ulcer be produced, it should be treated like other syphilitic ulcers. In rare instances, where the testicle is totally disorganized, extirpation may become necessary.

ENCHONDROMATA OR CARTILAGINOUS tumours of the testicle are very rare. A beautiful example, however, is shewn in the accompanying illustration (Fig. 283). They may be known by their extreme hardness. Removal of the testicle is the proper treatment.

Malignant disease of the testicle generally occurs in the form of round-celled sarcoma, more rarely in the form of soft carcinoma; but, without a microscopical examination, the two diseases, even on section, are often quite indistinguishable. Sarcoma begins in the intertubular connective tissue, and most frequently occurs in early life; carcinoma in the tubules, as a proliferation of the

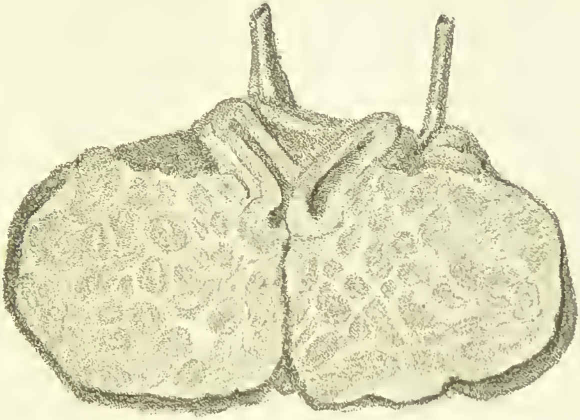


Fig. 283.—Enchondroma of the testicle.
(St. Bartholomew's Hospital Museum.)

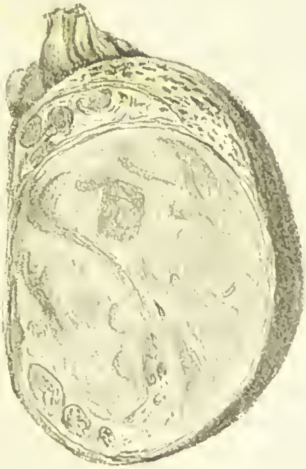


Fig. 284.—Soft carcinoma of the testicle.
(St. Bartholomew's Hospital Museum.)

epithelial lining, and is most common after the period of middle age. In both, the body of the organ is primarily affected, and all distinction between it and the epididymis is soon lost. Some effusion into the tunica vaginalis may at first occur ; the two surfaces, however, rapidly become adherent, the skin is implicated, and a fungating mass protrudes externally. The lumbar glands are generally affected, the inguinal only becoming involved after the skin has been reached. In a typical case (Fig. 284) the growth appears, on section, like a mass of brain-matter, blotched in places with blood; whilst fibrous bands, the remains of the trabeculæ testis, are generally seen traversing the growth. Masses of cartilage are often found in the sarcomata, and cysts, sometimes containing intracystic growths, are not uncommon (*cysto-sarcoma*). The disease formerly described as cystic sarcocele would generally appear to be of such a nature.

Signs.—The swelling is at first generally uniform, smooth, elastic or tense, and hard, and no distinction between the body and the epididymis can be made out; but later the cord becomes thickened and the lumbar glands enlarged, and the tumour may feel hard in one place and soft in another. Ultimately the skin becomes adherent, gives way, and a fungating mass, covered with a sanious discharge, protrudes.

Diagnosis.—The rapid growth, large size, and more or less globular shape of the tumour ; the lancinating pain ; the implication of the skin and lumbar glands ; the enlargement of the scrotal veins ; the protrusion of a bleeding fungus ; and later, the constitutional cachexia, will indicate malignancy. In the early stages, however, a puncture or even an exploratory incision may be necessary to distinguish it from chronic orchitis, hæmatocele, and syphilitic orchitis. Thus, in malignant disease, arterial blood will generally flow ; in hæmatocele, a chocolate-coloured fluid containing hæmatine crystals and broken-down blood corpuscles will escape ; and in chronic orchitis, whether simple, syphilitic, or tubercular, nothing beyond perhaps a drop or two of blood will be withdrawn by the cannula. At times a piece of the growth may come away in the end of the cannula, and a microscopical examination of this will further aid in the diagnosis.

Treatment.—Unless the glands are much affected, the cord is thickened, and great emaciation or cachexia is present, with signs of the disease in the internal organs, excision of the testicle should be performed. When this appears undesirable from the above-mentioned reasons, all that can be done is to give opium to relieve pain and tonics to keep up the general health, and to apply some disinfecting lotion to remove the fœtor attending the fungating mass. After removal of the testicle an early recurrence of the disease in the lymphatic glands or in the internal organs is only too probable.

Excision of the testicle.—The parts having been shaved, make an incision over the growth from the external abdominal ring to the bottom of the scrotum. Free the cord from its connections, and having clamped and divided it, enucleate the testicle with a few touches of the knife, taking care not to cut through the scrotal septum, and so remove the other testicle at the same time, a danger best avoided by giving the sound testicle into the charge of an assistant. Next tie the spermatic artery in the stump of the cord, and the cremasteric and deferential arteries, if seen; and having secured the cord by a Spencer Wells' forceps in order to prevent it slipping into the inguinal canal, loosen the clamp, and tie any other vessel that may then bleed before finally releasing it.

Atrophy of the testicle may be simply the result of old age; or it may be due to—1, inflammation, especially that occurring during an attack of mumps; 2, interference with its blood supply as from the compression of the spermatic artery by a new growth or aneurism; 3, obstruction to the venous return as in varicocele; 4, direct pressure on the organ, as by an old hæmatocele, or by the abdominal muscles or by a truss when the testicle is retained in the inguinal canal.

Neuralgia of the testicle is occasionally met with; but pain in the testicle should not be pronounced neuralgic till the various diseases of the kidney, rectum, bladder and prostate, which may give rise to reflected pain in the testicle, have been excluded. When no cause for the pain can be discovered, the ordinary neuralgic remedies should be given, although the prospect of success from their use is not great.

Retained testicle.—Non-descent of the testicle is said to be due to—1, the formation of adhesions in any part of its course into the scrotum; 2, disproportion between the size of the testicle and the abdominal rings;

3, paralysis of the gubernaculum testis; and 4, too short a condition of the spermatic cord. At times, the union between the vas deferens and the testicle, *i.e.*, the union of the Wolffian duct and the portion of blastema from which the body of the testicle is developed, does not occur, and the vas descends alone. The testicle may be retained in one of three situations, viz., 1, in the abdominal cavity; 2, in the inguinal canal; and 3, just outside the external abdominal ring. In the two latter situations it is often associated with a congenital hernia.

Treatment.—In the first situation nothing can be done. In the third, the testicle should be coaxed into the scrotum by gentle and oft-repeated manipulations, and a truss applied over the inguinal canal should there be signs of a hernia. When the testicle is retained in the inguinal canal, time should be given it to descend, and a truss applied if possible over the internal ring. Should it not descend as the child grows older, the question of its removal must be raised, as in this situation atrophy of the organ is nearly sure to ensue, and it is liable to be frequently attacked by inflammation, and to be affected by malignant disease. Moreover, it exposes the patient to the risks of hernia. In some cases, however, it may be returned into the abdomen, and kept there by a truss.

SURGICAL DISEASES OF THE FEMALE GENITAL ORGANS.

DISEASES OF THE VULVA.

ADHESION OF THE LABIA MAJORA sometimes occurs as a congenital affection. The labia should be separated by forcibly drawing them asunder, with the assistance, if necessary, of a probe, and a piece of iodoform gauze placed between them to prevent re-adhesion. If neglected, it may be a source of inconvenience at puberty. The parts are then more firmly adherent, and may require division by the knife.

VULVITIS, or inflammation of the vulva, is in adults most usually the result of gonorrhœa, but may occasionally occur, especially in strumous children, from other causes, such as cold, injury, the irritation of thread-worms, &c. Sometimes the sebaceous glands and hair-follicles of the labia are chiefly affected, the parts then appearing dotted over with small red pimples, and later, if suppuration occurs, with small pustules. There is usually much redness and œdema, and an offensive discharge. It is of some importance to recognise the fact that the disease may occur in children from simple causes, as, amongst the poor, mothers are apt to think their child has been tampered with. *Treatment.*—In addition to removal of the cause, cleanliness, rest, attention to the general health, and the use of a mild astringent lotion, is all that is usually required.

ABSCESS occasionally follows inflammation of the vulva. It is often due to the extension of inflammation (generally gonorrhœal), to Bartholin's gland, or to suppuration in a labial cyst. A free and early incision should be made to prevent burrowing of pus, which is otherwise apt to occur, leading to the formation of obstinate fistulæ.

CYSTS in the labium are generally due to the obstruction of a mucous follicle or the duct of Bartholin's gland, as the result of irritation. Dermoid and sebaceous cysts are more rarely met with. The mucous cysts generally contain a glairy fluid, and as their walls are thin, appear as semi-translucent, oval, elastic swellings. They occasionally suppurate. Excision of a portion of the wall, and cauterization, plugging, or scraping away the lining membrane to ensure healing from the bottom, is all that is usually necessary.

TUMOURS.—*Fibrous tumours* are occasionally met with in the labium. They are usually of the soft variety, and often contain myxomatous elements. They are frequently allowed to attain a large size. Removal is the only treatment. *Fatty tumours*, and *nævi* are also met with; *sarcomata* but rarely.

Epithelioma is not uncommon, and may generally be distinguished from venereal warts, and syphilitic, tubercular or lupoid ulceration by the surrounding induration, the sinuous and everted edges of the ulcer, the history of the case, the age of the patient, and the early enlargement of the inguinal glands. Early and wide removal of the growth, together with any inguinal glands that may be felt enlarged, holds out the only prospect of success; but when the growth has attained any size, a rapid recurrence is but too frequent.

CONDYLOMATA AND VENEREAL WARTS are very common in this situation. They require no special description, and should be treated as described under *Venereal Diseases in the Male.*

PRURITIS may depend on various causes. These should be sought, and, if possible, removed; and the irritation allayed in the meantime by such remedies as are mentioned under *Pruritus ani* (p. 658).

ELEPHANTIASIS OF THE LABIUM is rare. Like the similar condition of the scrotum, it may attain a large size. It may be removed by the knife, or better, as the hæmorrhage is free, by the galvano-cautery.

NOMA is an infective inflammation of the vulva, attended by phagedænic ulceration, and is not infrequently met with in the ill-fed, weakly children of the poor, especially after the exanthemata. Like cancrum oris, it probably depends upon the presence of a specific micro-organism. It begins as a dusky-red, indurated patch on one labium, with much swelling and œdema, and spreads rapidly, the central parts often becoming gangrenous. It is attended with severe constitutional disturbance, which soon assumes the typhoid type, and death from exhaustion or septicæmia frequently ensues. The *treatment* should be energetic. The affected part should be completely destroyed by fuming nitric acid or the galvano-cautery, and an antiseptic dressing applied; whilst fluid nourishment, stimulants, and iron should be freely given, and opium cautiously administered in doses suitable to the age of the child. In milder cases, the application of boro-glyceride may suffice. In very severe cases, the continuous warm bath has been found of great service.

DISEASES OF THE VAGINA.

ACUTE VAGINITIS is generally due to gonorrhœa, but may occur as the result of the use of strong injections, the introduction of foreign bodies, cold, and the exanthemata. It is attended with the signs of inflammation, and with a profuse, generally purulent, and sometimes blood-stained discharge. There is pain on urination and defæcation, and tenesmus. The inflammation may spread to the uterus, and thence to the Fallopian tubes, or to the urethra and Bartholin's glands. Saline purgatives, rest, warm hip-baths, and cleansing the part with Condy's lotion, followed by astringent injections, is the proper treatment.

TUMOURS of the vagina are rare, and require no special notice.

CYSTS of the vagina are occasionally, though rarely, met with as the result of the distension of the mucous follicles; and others are described as originating from remnants of the Müllerian duct, or from the dilatation of lymphatics. They should be treated by the excision of a portion of the cyst-wall, combined with cauterization.

VESICO-VAGINAL FISTULÆ are generally the result of sloughing, consequent upon the pressure of the child's head in a prolonged or instrumental labour, though they may be occasionally produced in other ways, as from the impaction of a foreign body in the vagina or urethra, injury, &c. They give rise to incontinence of urine, and are productive of great inconvenience. They may be so small as merely to admit a probe, or nearly the whole of the anterior wall of the vagina may be destroyed. The common situation is just below the neck of the uterus. *Treatment.*—Where the fistula is very small, touching it with the actual cautery may succeed in closing it; but an operation is usually necessary. The rectum having been cleared by an enema, the patient should be placed in the lithotomy position, and a duck-bill speculum introduced. The edges of the fistula should then be pared, and brought together with silver-wire or silk-worm gut suture. The sutures should be placed sufficiently close to prevent the passage of urine between them. A good way of testing if they are close enough, is to inject milk into the bladder, so that should any escape through the fistula, its colour will make it visible. Smith's needle will be found very convenient if wire sutures are used. The bladder should be emptied by a catheter at regular intervals; the vagina syringed out with an antiseptic solution, and dusted with powdered iodoform; and the bowels kept confined for a week or more.

RECTO-VAGINAL FISTULÆ may occur from causes similar to those leading to the vesico-vaginal variety; they are also sometimes congenital. They are commonly situated just within the entrance to the vagina, and may be closed in the same way as the vesico-vaginal fistula.

UTERO-VESICAL AND UTERO-RECTAL FISTULÆ may also occur, but are too rare to require any description here.

IMPERFORATE HYMEN, if overlooked till after puberty, is a serious affection, as the vagina, and later the uterus and Fallopian tubes, may become distended with the retained blood, conditions known respectively as *hæmato-kolpos*, *hæmato-metra* and *hæmato-salpinx*. If relief is not obtained, enormous distension may occur, and the tubes or uterus give way, setting up peritonitis. Or the hymen itself may yield, and all end well; or sapræmia may occur from putrefaction of the blood and absorption of the septic products on the admission of air; or septic peritonitis may be produced by the sudden alteration of pressure or the contraction of the uterus causing rupture of the tubes and escape of fluid into the peritoneum. *Treatment.*—Before puberty, division or excision of a portion of the hymen is a simple and safe operation; but when distension has occurred, it is attended with great risk, as if a free opening is made there is danger of peritonitis from the same causes as when spontaneous rupture occurs; and if a small opening is made, of sapræmia from decomposition. The safest plan, perhaps, is to make a small opening, and to keep the parts aseptic by iodoform or the like.

MALFORMATIONS OF THE VAGINA.—*Atresia* or *imperforate vagina.* The vagina may be completely absent, or divided by a transverse or horizontal septum. The uterus and ovaries may also be absent, and no trouble will then result; but when these are present, similar results to those described under imperforate hymen may follow. Atresia of the vagina may also be due to adhesions or the contraction of cicatrices following ulceration, &c. The absence of the uterus may be determined by introducing a catheter into the bladder, and the finger into the rectum, when the two will be felt to be in close apposition. In such a case no operation should be undertaken, as all that would be achieved would be to open the peritoneal cavity. Where the uterus and ovaries are present, and distension has occurred, if the vagina is only partially absent an attempt may be made to form a vagina by dissecting carefully through the tissues between the bladder and the rectum in the direction of the os. When this is found, the parts must then be prevented from re-adhering by introducing laminaria tents, frequent digital examinations, &c. Where the vagina is completely absent the uterus may become distended, and may then either be punctured through the rectum, or in some instances together with the ovaries be removed.

CYSTOCELE AND RECTOCELE are the names given to a prolapse of the anterior and posterior wall of the vagina respectively. In the former the bladder of course protrudes; in the latter the rectum. They are frequent accompaniments of extensive ruptures of the perinæum. These affections generally fall under the care of the obstetrician, but at times the Surgeon may be called upon to perform a plastic operation for their cure. This consists in removing a portion of mucous membrane from the upper or lower wall of the vagina as the case may be; bringing the raw surfaces together with sutures; and keeping the bladder empty with a catheter till firm union has taken place.

DISEASES OF THE OVARIES AND FALLOPIAN TUBES.

Ovarian tumours.—Ovarian tumours may grow either from the ovary itself, or from the broad ligament, and may be either solid or cystic. Amongst the solid tumours, which are rare, carcinoma and sarcoma are the most common. Amongst the cystic the so-called multilocular cysts are most frequently met with; but other forms, as the unilocular, the dermoid, and the parovarian cysts, may also occur. For a description of these tumours and of their pathology, which, at the best, is but imperfectly understood, the student must be referred to a special work on the subject.

Symptoms.—There may be no symptoms at first; but as the tumour increases in size, it gradually encroaches on the space normally allotted to the pelvic and abdominal viscera, giving rise to one or more of the following symptoms. Thus, from pressure on the bladder and rectum there may be increased micturition and constipation; from pressure on the iliac vessels, œdema of the lower limbs and genitals; from pressure on the sacral and lumbar plexus, pain in the back, pudenda, and legs; from pressure on the stomach, nausea and vomiting; on the intestines, diarrhœa or colicky pains; on the portal vein, ascites and hæmorrhoids; on the kidneys and ureters, albuminous and highly-concentrated urine rich in urates. Later, as the tumour extends upwards, there will be embarrassed breathing and dyspnœa from pressure on the heart and lungs; whilst finally emaciation sets in, and the patient dies of exhaustion, if not carried off by an intercurrent attack of peritonitis from rupture of the cyst.

The physical signs vary according to the size of the cyst, and the diagnosis at first may be attended with some difficulty. But as the cyst rises out of the pelvis, and the abdomen becomes gradually distended, the condition known as ovarian dropsy is produced, the physical signs of which somewhat resemble dropsy of the peritoneum (*ascites*) depending on visceral disease. In *ovarian dropsy* the abdomen is dull in front, resonant in the flanks; the dulness is not altered by position; and the distension is greatest in the hypogastric and umbilical regions. Whereas in *ascites* the abdomen is resonant in front, dull in the flanks; the dulness is altered by position, the dull flank becoming resonant when the patient is placed on the opposite side; the distension is most marked laterally; and the circumference of the abdomen is greatest at the level of the umbilicus. In both a percussion wave or thrill generally exists, but in ovarian disease it is usually limited to the dull area, whilst in ascites it is as a rule felt all over. In ascites, moreover, there is probably other evidence of the visceral disease which is producing the dropsy; and if the abdomen is punctured the fluid will be found to be of a thin and serous character. In ovarian disease the uterus is usually displaced. An ovarian tumour may also have to be distinguished from pregnancy, tympanites, encysted dropsy of the peritoneum, tumours of the omentum, subperitoneal cysts and tumours, fibroids of the uterus, pelvic hæmatocele and abscess, extra-uterine pregnancy, and a distended bladder; but the differential diagnosis cannot be attempted in a work of this character. Having, however, determined that the disease is an ovarian cyst, the next point to make out is whether it is unilocular or multilocular; free or adherent. The *multilocular* cyst is usually irregular; fluctuation is absent, or more marked in some parts than in others; and there is no thrill or fluctuation wave on percussion, unless one of the cysts has attained a preponderating size. The *unilocular* cyst is smooth, rounded, regular, and elastic; fluctuation is felt equally over the whole tumour; and the percussion thrill or wave is equally distributed over the whole of the dull area. If *adhesions are present* the cyst is fixed, unless they take the form of elongated bands, in which case a friction rub or sound may be felt or heard. The umbilicus moves with the cyst; but no movement is detected on examination by the rectum or vagina. If *there are no adhesions* the cyst moves on respiration, but the umbilicus does not move with the cyst, and it is not found fixed on examination by the rectum or vagina. Such are the chief points to be attended to; but often the signs are delusive, and where a tumour is expected to be of a unilocular character and free, it may be found to be multilocular or solid and extensively adherent to the neighbouring parts.

Treatment.—The only effectual treatment is to remove the tumour by the operation of ovariotomy, an operation which, though formerly attended with a high rate of mortality, may now be said to be one of the most successful of the major operations in surgery. Repeated tappings, and tapping and injecting with tincture of iodine, have now very rightly almost ceased to be employed, although tapping may still at times be called for under exceptional circumstances, which cannot here be discussed. Before ovariotomy is undertaken, however, the patient should be very carefully prepared by attention to the bowels and kidneys, any congested condition of the latter being relieved by aperients, diaphoretics, warm baths, and the administration of citrate of potash, lithia, &c.

OVARIOTOMY.—The patient having been well wrapped up, with woollen stockings on the legs, &c., the bladder emptied by a catheter, the skin of the abdomen previously cleansed with soap and water and antiseptics, and the anæsthetic administered, a mackintosh cloth with an oval opening is placed over the abdomen and secured round the opening to the skin by adhesive material. The parts should then be again sponged with antiseptics, and an incision made in the middle line about three inches long midway between the pubes and the umbilicus (Fig. 224, A). This incision may be afterwards prolonged if necessary. The peritoneum having been reached, and all hæmorrhage stopped with pressure forceps, the peritoneal cavity is carefully opened on a director, the hand introduced, and adhesions felt for. If the cyst is free, Spencer Wells' trocar and cannula is thrust through the cyst-wall, the fluid evacuated, and the cyst gradually drawn out through the wound as it is reduced in size by the escape of the fluid. The pedicle is now transfixed by a long needle armed with a suture of China silk, the suture severed, and the needle withdrawn. The two portions of suture are next twisted, and the pedicle firmly tied on both sides. The pedicle is then divided on the cyst aspect, and the cyst removed, care being taken to prevent any of its contents escaping into the abdomen. If the cut surface of the pedicle appears dry, the sutures by which it is tied are cut off short, and it is allowed to slip back into the pelvis; but if any bleeding point is seen, this must first be secured. Should adhesions be felt on opening the abdomen, they should be carefully broken down by the hand, or divided, if necessary, care being taken not to injure the intestines, and to secure all bleeding vessels. After the cyst has been removed, the other ovary should be examined, and if diseased, also removed. The sponging-out or irrigation of the abdomen is now begun, and must be continued as long as any blood-stained fluid can be squeezed from the sponges. The sponges, or better Gamgee's pads, should be thrust down deeply into Douglas's pouch, and when all the blood-stained fluid has been removed from this part of the peritoneum, a sponge attached by a string should be left there until just before closing the wound to ensure that no collection remains in this dependent situation. If irrigation is employed, an india-rubber tube attached to a can containing the irrigating fluid should be passed in various directions into the abdominal cavity, and the fluid allowed to flow until it runs away perfectly clear. The irrigating fluid may consist of water at a temperature of 98°, containing some antiseptic. Mr. Tait uses pure water. A large soft sponge is finally placed over the surface of the intestines whilst the deep parietal sutures are being introduced. These should be passed about half an inch apart, and made to include the skin and peritoneum, but not the muscles, so that when tied two free surfaces of peritoneum are in contact. The sutures being all *in situ*, the flat sponge and the sponge in Douglas's pouch are withdrawn, and the wound is closed by tying the sutures. Superficial sutures are next introduced between the deep to ensure the accurate apposition of the skin. The mackintosh is now removed, a gauze-dressing firmly secured by strips of strapping, and a flannel bandage applied over all. The operation may be done under the spray; the hands and instruments should be cleansed both in carbolic acid and corrosive sublimate lotions. The *after-treatment* consists in keeping the patient at rest, soothing pain and procuring sleep by morphia, emptying the bladder at regular intervals by the catheter, and allaying vomiting if present by ice or if intractable by washing out the stomach. Tympanites is greatly relieved by the occasional passage of a long rectal tube. No food should be given for the first twenty-four hours; then nutrient enemata should be administered, and after three days a return to slop diet should be cautiously made. The stitches may be removed from the third to the seventh day, and the wound then supported by strapping. If signs of peritonitis appear, Mr. Tait gives a turpentine enema and saline purge. See *Peritonitis* (p. 391).

SALPINGITIS—HYDRO-SALPINX—PYO-SALPINX—HÆMATO-SALPINX.—As the result of gonorrhœa, inflammation of the uterus or pelvic peritoneum, and occasionally of parturition, the Fallopian tubes may become inflamed (*salpingitis*), and their orifice adherent, and as a consequence they may become distended with serum (*hydro-salpinx*) or with pus (*pyo-salpinx*); whilst much more rarely, as the result of an injury or from obstruction in the uterus or vagina, they may become distended with blood (*hæmato-salpinx*). The symptoms are pain, worse on exertion, straining, or coitus; and intensely painful, irregular or profuse menstruation, together with a history of uterine or ovarian trouble. On examination an ovoid, generally tender, perhaps fluctuating swelling will be felt externally and through the roof of the vagina, and on both sides if both tubes are affected. The swelling will be moveable or immoveable according as it is free or adherent, and may be distinguished from an ovarian cyst by its shape, and by being felt anteriorly rather than on either side of the neck of the uterus. Pyo-salpinx may generally be distinguished from hydro-salpinx by the occurrence of rigors and fever; but a diagnosis is often impossible.

Treatment.—The removal of the tube and ovary in the case of hydro- or pyo-salpinx is the treatment that has been adopted; but it should only be done when the symptoms are severe. Tapping through the vagina has not been attended with success. The operation of removal may be done in a manner similar to oöphorectomy. Hæmato-salpinx, as a rule, requires no active treatment.

OÖPHORECTOMY, OR BATTEY'S operation, consists in the removal of the ovaries, and has been done for inflammation, neuralgia, amenorrhœa, &c. The operation is performed like ovariotomy. A small incision being made in the linea alba, midway between the umbilicus and the pubes, two fingers are introduced into the peritoneal cavity, and first one, and then the other ovary brought out of the wound. The pedicle, which consists of broad ligament and its contained structures, is transfixed and ligatured as in ovariotomy, the ovary cut off, and the pedicle dropped back into the abdomen.

HYSTERECTOMY, or REMOVAL OF THE UTERUS, may be done through the vagina (*Schrœder's operation*) or through an incision in the abdominal walls (*Freund's operation*). In the former, an incision is made through the vaginal mucous membrane around the cervix, the peritoneal cavity opened, the broad ligament transfixed and ligatured, and the uterus severed from its connections and drawn out through the vagina. In the operation through the abdominal wall, the peritoneal cavity is opened, as in ovariotomy; the broad ligament transfixed and ligatured; and the uterus drawn up from the pelvis and carefully severed from its connections. For a detailed account of these operations, however, the student is referred to a larger work.

DISEASES OF THE BREAST.

NEURALGIA of the breast is not uncommon in young unmarried women, and appears to be frequently due to some ovarian disturbance. The pain is often severe, perhaps shooting down the arm, and may be constant or periodic; whilst the skin over the breast, as well as the gland itself, is exceedingly sensitive on handling. Nothing, except at times a slight fulness, can be detected on examination. The *treatment* consists in improving the general health by tonics, cold baths, and outdoor exercise, and in regulating the ovarian functions. No local treatment is necessary; indeed, the patient's attention should be taken off the breast as much as possible.

INFLAMMATION OF THE BREAST may occur at any age, and in the male as well as in the female. In *infants* it is sometimes attended with a serous or milky discharge from the nipple, and is often made worse by ignorant nurses applying friction to "rub away the milk." *At or about puberty* it is met with in boys as well as in girls, but more frequently in the latter. Often beyond the patient appearing somewhat out of health no cause can be discovered, although in hospital patients a history of a blow is not uncommon. The inflammation may clear up, or terminate in an abscess.

ACUTE INFLAMMATION, however, most frequently occurs during *lactation*, especially in primiparæ, and generally during the first month after parturition. It then appears to be most often due to the irritation of the nipple by the child sucking, particularly when the nipple is shrunken or retracted, or is in a cracked condition. Occasionally it is the result of excessive secretion of the milk and consequent hyperæsthesia of the ducts; or it may not appear till later during the period of lactation, when the patient's powers have been pulled down by long suckling.

Symptoms.—A feeling of uneasiness in the breast, then a chill or slight rigor, followed by fever and the local signs of inflammation and often subsequently of abscess.

Treatment.—The breast should be placed at perfect rest by slinging it in a handkerchief passed over the shoulder, and by taking away the infant from the sound as well as from the affected side; the milk should be drawn off regularly by the breast-pump; and belladonna and glycerine applied to diminish the secretion, and opium or poppy fomentations to relieve pain. Signs of abscess must be watched for and an early incision made. A smart saline purge, followed by saline laxatives and a light nutritious slop diet, is usually necessary.

ABSCESS OF THE BREAST may occur in three situations:—1. Superficial to the gland (*supra-mammary abscess*); 2. In the substance of the gland (*intra-mammary abscess*); and 3. Behind the gland (*post-mammary abscess*). 1. The supra-mammary variety resembles an abscess in any other situation and requires no further comment. 2. The intra-mammary, which is generally the result of inflammation occurring during lactation, may be confined to one part of the gland; or pus may be formed in several situations at the same time, and if not let out by timely incisions may riddle the breast in all directions. 3. In the post-mammary the inflammation begins either in the cellular tissue behind the breast, or in the posterior lobes of the gland, the resulting abscess then bursting into the cellular tissue behind the breast. The whole breast is pushed forwards and presents a characteristic conical appearance. There is deep-seated and throbbing pain, increased on moving the arm, and some œdema and mottled redness of the skin. The pus usually gravitates towards the lower and outer part of the breast, where the abscess commonly points; or it may burrow through the gland, producing fistulous tracks which are often very difficult to heal.

Treatment.—In all varieties an early and free incision should be made preferably under an anæsthetic. In the intra-mammary the incisions should radiate from the nipple, so as not to cut across the galactophorous ducts;

and should be free, not a mere puncture, lest the abscess cavity degenerate into a sinus. In the post-mammary the incision should by preference be made at the most dependent part to ensure an efficient drain, though of course pus wherever pointing must be let out. Should sinuses or fistulæ form, they should be laid freely open and thoroughly drained, after being scraped by a Volkmann's spoon. The strength should be supported by a generous diet, and ammonia and bark, or quinine and iron given, together with stimulants, if indicated.

Chronic lobular inflammation of the breast, which has been described by various names, as lobular induration, chronic hypertrophy, chronic interstitial mastitis, &c., affects generally one lobe, or limited portions of the gland, and is of much interest in that it is liable to be mistaken for a tumour. It is said to be most frequent in married women beyond the child-bearing period of life; but my own experience is that it is as often met with in young and unmarried women.

Cause and pathology.—It is generally attributed to ovarian disturbance. A small-cell-infiltration occurs in the connective tissue of the affected lobe with increased proliferation of the epithelium. Later the cells develop into fibrous tissue, which contracts, pressing upon and obliterating the ducts and acini, and causing fatty degeneration of the epithelium lining them. Should some of the acini escape the pressure which has obliterated the ducts leading from them, small cysts may be formed; but such cysts never attain a large size in consequence of the unyielding nature of the fibrous tissue by which they are surrounded.

Symptoms.—The patient usually complains of a swelling, and sometimes of pain in the breast. On grasping the breast between the fingers the hypertrophied portion feels like a tumour, but on drawing it from the nipple so as to make the lactiferous ducts tense, it is found to be part of the mamma, and on pressing the breast back on the ribs with the flat of the hand no distinct tumour is felt, nor anything like the resistance of a new growth. Further, the swelling is usually of a wedge-shape, with its apex towards the nipple, and has not the stony hardness of scirrhus; and there may be a second nodule in the same breast, or in the breast of the opposite side. The axillary glands are sometimes enlarged but are not indurated, and the pain often follows, as pointed out by Mr. Birkett, the distribution of one or more intercostal nerves, the slightest pressure upon which as they issue from the thorax causes acute pain. The above signs will usually serve to distinguish the affection from scirrhous carcinoma. Should, however, as occasionally happens, the nipple be retracted, the skin dimpled from the contraction of the fibrous septa, the surface of the gland rendered nodular by the presence of several tense cysts, and the patient moreover be about the age at which carcinoma is common, it may be difficult to diagnose between them, especially if the breast is voluminous, so that the characters of the swelling are obscured. Under such circumstances it is quite justifiable to make an exploratory incision, after having explained the importance of a correct diagnosis to the patient.

Treatment.—Iron and quinine or the mineral acids are often indicated, and with these some combine the iodide of potassium. Locally a belladonna plaster may be applied, or the stays dispensed with to prevent friction, or a thick layer of cotton-wool placed between them and the breast. Inunction with iodide of potassium ointment, or with oleate of mercury, is also recommended. Whatever treatment is adopted, it should be persevered in for several months.

There is a condition of *Hypertrophy* often met with in lads about the age of puberty, and in girls a little below that age. The breast enlarges slowly, often painlessly, generally on one, but sometimes on both sides. There are no signs of inflammation. Under the influence of a belladonna plaster applied for some months, which probably owes its efficacy to the fact that it prevents the patient irritating the breast by constantly feeling it, the hypertrophy usually subsides. Of its exact pathological condition I am not aware, but it appears probable that it is of a chronic inflammatory nature.

TUMOURS OF THE BREAST.—The tumour by far the most frequently met with in this situation is the acinous carcinoma (*scirrhus*), which is due to the proliferation of the epithelium lining the acini or the ducts. Certain of the connective-tissue tumours (*fibromata*, *sarcomata*), springing from the periacinous connective tissue, are also of frequent occurrence. They seldom, however, occur pure, but are nearly always mixed with elements resembling the tissue of the breast itself (*adenomatous tissue*), and hence are spoken of as adeno-fibroma, adeno-sarcoma, adeno-myxoma. Whether these adenomatous elements are the normal breast-tissue, which has become surrounded and enclosed in the fibrous or sarcomatous growth, as the case may be, or whether it is an abortive formation of the gland-tissue, is not agreed upon by pathologists. Most, however, believe that it is a new formation. More rarely the gland-tissue may constitute the chief bulk of the tumour (*pure adenoma*). The tumours composing this class were formerly spoken of collectively as *chronic mammary glandular tumours.* At times cysts are developed in connection with them, and they are then designated *cystic adeno-fibroma*, *cystic adeno-sarcoma*, *cystic adeno-myxoma*, &c. Various other forms of tumour, viz., tumours composed of fat, cartilage, vessel-tissue, nerve-tissue, &c., have also been met with in the breast, but are exceedingly rare.

PURE ADENOMATA are very rare. They occur as circumscribed ovoid tumours surrounded by a capsule of connective tissue. On section they appear smooth, lobed, white or tinged with pink, with here and there small cavities and occasionally distinct cysts. Their general characters have already been given under *Tumours.* All that need here be repeated is that they consist of acini and ducts surrounded by a small amount of vascular connective tissue; in short, that they resemble the breast preparing for lactation, save that the acini and ducts do not form distinct lobules with an excretory duct, as in the lactating breast. Further, the epithelium does not penetrate the membrana propria and grow into the intertubular and inter-acinous connective tissue, a point of importance as distinguishing them from carcinoma.

Signs.—They are most often met with in women between the ages of thirty and thirty-five who have borne children, as small ovoid, firm but elastic, distinctly circumscribed and moveable growths in the breast, with a nodular or slightly bossed surface. They are of very slow growth, do not cause retraction of the nipple or enlargement of the axillary glands, and do not return if completely removed. Enucleation is the *treatment.*

ADENO-FIBROMATA are of frequent occurrence. They consist of fibrous and adenomatous tissue, and are styled *fibromata* by those pathologists who regard the gland-tissue as merely the remains of the normal breast-tissue surrounded by the new growth. They occur as firm, circumscribed, slow-growing and distinctly encapsuled tumours in the substance of the breast, and on section appear lobulated and of a pinkish-white colour, and do not yield a juice on scraping.

Signs.—They usually occur in the breast of young and healthy women as freely moveable, firm, ovoid, slightly nodular, generally painless growths, and are often indistinguishable without puncture from a tense cyst. From carcinoma and sarcoma they may be diagnosed by the age of the patient, their slow growth, well-defined outline, non-retraction of the nipple, non-adherence of the skin, and the absence of glandular enlargement. From pure adenoma, adeno-sarcoma, and adeno-myxoma, it may be impossible to distinguish them before removal. Enucleation is the only effective *treatment.*

ADENO-SARCOMATA differ from the adeno-fibromata in that in place of an increase of fibrous tissue around the acini and ducts various kinds of sarcoma-elements are found mixed with more or less mature fibrous or myxomatous tissue; they often contain cysts. Hence the terms adeno-fibro-sarcoma, adeno-myxo-sarcoma, adeno-cysto-sarcoma, fibro-cysto-sarcoma, &c., which have been applied to them. They occur as circumscribed growths in the breast, resembling the adeno-fibromata, from which it is often impossible to distinguish them without a microscopic examination.

The signs vary according to the amount of sarcoma-elements the growth contains. Thus, when this is small they approach in their clinical character and behaviour the adeno-fibromata. On the other hand, when sarcoma-elements abound, they may grow rapidly, and behave like the pure sarcomata. Frequently they grow slowly for many years and then suddenly rapidly increase in size as the patient approaches the middle period of life. When occurring between the ages of thirty and forty they often grow rapidly from the first.

Treatment.—The slow-growing and more fibrous forms may be enucleated, but if in proceeding to do this the growth is found to be soft and succulent the whole breast should be excised, an operation that should invariably be undertaken when the tumour has grown rapidly.

PURE SARCOMATA.—All forms of sarcoma mixed with fibrous and adenomatous elements may occur in the breast, the large-spindle-celled variety being the most common. They are most frequent between the ages of twenty and thirty-five. They begin in the periacinous and peritubular connective tissue, and at first are always encapsuled, but later they infiltrate the surrounding parts and may perforate the skin and fungate. Their malignancy depends upon their structure, the round-celled and large-spindle-celled being highly malignant, the small-spindle-celled much less so; indeed, the latter may recur again and again *in situ* before finally becoming disseminated, or its tendency to recurrence may completely wear itself out. The small-spindled-celled is usually firm like the adeno-sarcomata, and on section greyish-white, smooth and succulent. The round-celled and large-spindle-celled are soft and elastic owing to their richness in cells and blood-vessels and their scanty amount of intercellular substance. On section they appear of a pinkish-white colour, often blotched with blood, while cysts from hæmorrhages and mucoid softening sometimes occur in them.

Symptoms.—The small-spindle-celled sarcoma can hardly be diagnosed before removal from the adeno-fibroma and adeno-sarcoma. The large-spindle-celled and round-celled varieties form smooth elastic tumours, oval or rounded in shape, and are lobed or bossed when cystic; whilst the veins of the breast are often enlarged and tortuous. They grow rapidly, and may perforate the skin and protrude as a fungus; but, unlike carcinoma, they do not infiltrate the skin or cause retraction of the nipple, and the glands are not usually enlarged. The tumour, moreover, is commonly larger than scirrhus, and the patient's age below that at which carcinoma is usually met with.

The only effectual *treatment* is the removal of the whole breast. If there is any doubt whether the tumour is an adeno-fibroma or a sarcoma it is better to have the consent of the patient before the operation for the removal of the whole breast should the tumour when cut into appear to have malignant characters.

CYSTO-SARCOMATA, adeno-cystomata, sero-cystic sarcomata, and glandular proliferating cysts, are terms applied to tumours in the breast in which the growth in the periacinous connective tissue projects into the interior of dilated acini and ducts in the form of papillary or cauliflower-like masses. The periacinous growth, which may consist of fibrous tissue, spindle or round cells, or of a mixture of all these, protrudes the wall of the dilated acinus or duct in front of it, but does not penetrate the epithelial lining, and may ultimately fill the whole acinus, which is thus converted into a mere slit-like space lined with epithelium. On section the tumour may present one or more larger cysts, containing variously-shaped cauliflower-like growths sprouting from their walls. Or it may appear completely solid from the cysts having been entirely filled with intra-cystic growths; on dissection, however, the spaces between the growths and the cyst-walls can always be demonstrated. When the growth, which is at first encapsuled, attains some size, the skin may give way and the growth protrude in the form of a fungus. The skin, however, does not become infiltrated as in carcinoma.

Signs.—They generally occur in women between the ages of thirty and thirty-five, as distinctly defined, lobulated, usually painless growths, hard in some places and soft and fluctuating in others, and often of large size. The veins over them are enlarged, but the skin is not adherent, the nipple is not retracted, and the glands as a rule are not affected. They commonly grow slowly, but at times rapidly, and seldom become disseminated. Their chief distinguishing characteristic is the presence of one or more prominent fluctuating cysts in the tumour. Should a fungus protrude it may be distinguished from carcinoma by the non-implication of the skin around, non-adherence of the growth to the side of the chest, and the absence of the other signs of carcinoma above pointed out. Removal of the breast is the proper *treatment.*

CYSTS.—The cysts met with most frequently in the breast are the serous cysts, and certain of the retention cysts. *Serous cysts* are formed in the breast, as in other situations, by the distension with fluid of the lymphatic spaces of the connective tissue (see *Serous cysts*). The *retention* cysts that occur in the breast may be divided into the *galactoceles*, which are produced by the dilatation of the galactophorous ducts, and the *glandular* cysts, due to the distension of the smaller ducts and acini. The former contain a milk-like fluid, or when, as occasionally happens, the watery parts have been absorbed, an inspissated caseous material. The glandular contain a yellowish or brownish-yellow mucoid fluid, sometimes blood-stained, and at times intracystic papillary growths, formed by the in-growing of the cyst-walls. When they occur in elderly people they are spoken of as *involution* cysts. Their frequency in chronic lobular inflammation of the breast has already been alluded to.

Signs.—Cysts in the breast form painless, tense or semi-fluctuating, smooth, rounded tumours, evidently connected with the breast tissue. *Serous cysts* may occur in any part of the breast. They are often very tense and hard, and breasts with such in them have been removed for cancer. Hence the valuable rule of making a preliminary incision if in doubt as to the nature of the tumour. The *galactoceles* occur during lactation; they are situated near the nipple, from which a milk-like fluid may sometimes be squeezed out on pressing the cyst. They are soft and fluctuating, and usually single, form quickly, and may attain a large size. *Glandular* cysts occur chiefly in women of from thirty-five to fifty. They are tense and painless, form slowly, may occur singly, but are often multiple. A sanious fluid sometimes escapes from the nipple.

Treatment.—*Simple serous cysts* should be laid freely open and allowed to granulate from the bottom. *Galactoceles* with semi-solid contents, may also be laid freely open and their contents squeezed out. *Glandular cysts*, when numerous, call for the excision of the affected lobule, or if the whole breast is affected and they contain proliferating growths, excision of the entire gland. Involution cysts require no treatment.

CARCINOMA of the breast is nearly always of the acinous form, of which both varieties, the hard (*scirrhous*) and the soft (*medullary*), are met with. The hard variety, however, is by far the more common. The general and microscopical characters of carcinoma have already been given under tumours. Here only the special characters which it presents when occurring in the breast will be referred to.

SCIRRHOUS CARCINOMA.—*Pathology.*—Scirrhus of the breast generally appears as an indurated, nodular, non-encapsuled, tuberous mass, of moderate dimensions, with long processes extending in various directions in the gland-substance and the fatty tissue around, and later, involving the skin and subjacent pectoral muscle. On section the tumour gives a characteristic creaking sensation to the knife, and the cut surface appears slightly concave from the contraction and shrinking of its fibrous stroma thus set free from the traction of surrounding tissues. It is of a hard resisting consistency, of a uniform close texture, semi-translucent, of a greyish-white colour often tinged with pink, and has been likened to the section of a potato or unripe pear. Sometimes it is intersected in every direction by short wavy glistening white fibres, with here and there yellow dots and streaks due to section of the epithelial columns which have undergone fatty degeneration; whilst in other places, little masses of the surrounding fatty tissue and of muscle are seen enclosed by the processes of the growth, and patches of caseous-looking material or white creamy fluid, due to the growth having surrounded some of the ducts which have become only partially obliterated, may be scattered through its substance. The section on scraping yields a juice containing cells, free nuclei, and granular material.

Signs.—Scirrhous carcinoma generally begins as a small hard lump in the substance of the breast; it grows slowly at first, afterwards more rapidly, and then involves the skin and pectoral muscle; finally the skin gives way, and a foul ulcer is produced. In the meantime, the lymphatic glands in the axilla become involved, and as they increase in size press upon the axillary vein and brachial plexus of nerves, producing œdema of the arm and intense neuralgic pain. Later the cancer becomes disseminated through the internal organs and tissues of the body. The health, which on the first appearance of the growth is generally good, now gives way, the skin becomes sallow and earthy in appearance, the patient wasted, and cancerous cachexia is said to be present. The foul and profuse discharge from the ulcer, the intense pain, and the mental suffering, lead to exhaustion, and death soon steps in to put an end to the patient's misery. Such is a brief outline of the course of the disease when not subjected to surgical interference. Let us now study the characters of the tumour as presented in a typical case. It is usually situated in the upper and outer quadrant of the breast, or just below the nipple. Its surface is hard and irregular, its margins ill-defined. The skin at first, when gently pinched up between the finger and thumb, shews a slight dimpling, and later appears distinctly puckered and unmistakably adherent to the growth. In the earlier stages the tumour glides freely over the pectoral muscle; later a slight resistance is felt on moving it from side to side; whilst finally it becomes firmly fixed to the walls of the chest. The nipple, when the growth is behind it, is retracted, in consequence of the traction which is made by the carcinoma upon the lacteal ducts; but when the growth is situated in the circumference of the breast, there may be no retraction, or the retraction may occur only on one side; whilst when the cancer begins as an infiltration of the nipple itself, the latter will be harder and more prominent than natural. On raising the arm and drawing the finger-tips transversely across the inner side of the axilla, a hard cord or cords—infiltrated lymphatic vessels—may often be felt extending from the tumour into the axilla, while in the space itself large glands will be discovered if the case is sufficiently advanced. The glands are at first soft, single, and distinct, later, hard and matted together, forming an indurated irregular mass which is often adherent to the chest-walls and in advanced cases extends as high as can be felt beneath the clavicle. In the supraclavicular space the enlarged glands may sometimes be detected, first as a mere fulness, subsequently as distinct swellings. After the skin over the tumour has given way, an ulcer with sinuous, irregular, everted, and indurated edges, and a foul, cavernous, irregular, and indurated base is formed, from which is exuded a foul-smelling and sanious discharge. The skin around is indurated from infiltration with the growth; or distinct, circumscribed, hard nodules of carcinoma are scattered here and there through it.

Diagnosis.—When the above signs are present there is no difficulty in pronouncing as to the nature of the disease. In the earlier stages, however, whilst the tumour is still small and has not yet become adherent to the skin or to the pectoral muscle, where the breast is large and there is no retraction of the nipple and as yet there is no enlargement of the axillary glands, the diagnosis from an innocent tumour, a tense cyst, or lobular inflammation will be, to say the least, difficult. The age of the patient, the rate of growth, and the history of the case must then to a great extent be relied on for distinguishing it. But where the patient, as is occasionally the case, is young, the diagnosis may then be impossible without making an incision into the growth, a proceeding which, under such circumstances, after the difficulty has been explained to the patient, is not only justifiable but imperatively called for.

Rarer forms of scirrhus in the breast are occasionally met with. Thus—1. The cancer may begin as a general infiltration of the entire gland, when its course is usually very rapid; 2, it may chiefly affect the skin, the whole side of the chest in such a case becoming infiltrated, hard, brawny and leathery in consistency, a condition sometimes known as "hide-bound;" 3, it may begin as an infiltration of the nipple, or may be engrafted upon chronic eczema around the nipple; 4, in elderly women it may run a very chronic course, often remaining stationary, if not interfered with, for many years; and, 5, in very exceptional instances, the carcinomatous mass has apparently undergone complete atrophy, even, it is said, after ulceration has occurred, and a spontaneous cure has thus been brought about.

Treatment.—In the breast, as elsewhere, the only hope of cure lies in the early and complete extirpation of the carcinoma. Unless, therefore, the Surgeon is consulted before the skin, pectoral muscle, and lymphatic glands are more than slightly involved, he can hold out but little prospect that the disease will not return, and return shortly; and that life will be materially, if at all, prolonged by an operation. Under such circumstances, therefore, there are some Surgeons who hold that an operation with the disease thus advanced ought not to be undertaken, as it can only bring discredit on surgery and may possibly prevent other patients seeking advice whilst there is yet a probability that a free and complete removal of the breast and axillary glands may eradicate the disease. While admitting that this may be true, we must not lose sight of the fact that even although the growth may soon recur either in the cicatrix or glands, or in internal organs, and although life may not be prolonged, still removal of the growth may rid the patient of a foul and loathsome disease and often of great pain, at any rate for a time, and death may occur in a less distressing way from dissemination of the carcinoma in internal organs. In the meanwhile the patient's mind will be relieved, even if she is not buoyed up with the hope that there may still be a chance of a non-return. Regarding the question of operation, therefore, it may be briefly said that—1. Where the skin is not involved, or to a very slight extent, the tumour not adherent to the pectoral muscle, and the glands are not felt enlarged, or if enlarged are not hard, free removal of the breast and clearing out the axilla is imperatively called for. 2. Where, on the other hand, the skin is extensively infiltrated, the tumour is firmly adherent to the pectoral muscle, the glands are enlarged, hard, and adherent to the side of the chest, enlarged glands can also be felt above the clavicle and perhaps have already caused œdema of the arm, marked cachexia is present, and there is evidence of dissemination of the carcinoma in other organs and tissues—then no operation should be performed. In cases such as the above, there can be little question as to the propriety of operating or not operating. But there are a large class of intermediate cases in which some Surgeons would, and some would not, operate. Much will then depend upon the presence or absence of pain, and each case must be judged on its own merits.

MEDULLARY CARCINOMA is much less common in the breast than the scirrhous form, and generally appears at an earlier age. It occurs as a soft, non-encapsuled, compact, white or blood-stained, brain-like mass infiltrating the gland and surrounding tissues. Its growth is much more rapid than the scirrhous variety, and it sooner involves the skin, pectoral muscles, and axillary glands, and rapidly becomes disseminated through internal organs. Early and free removal of the whole breast, and of any glands in the axilla that may be felt enlarged, is the proper *treatment.*

Other varieties of carcinoma in the breast, as the so-called *villous*, or duct-cancers, and the *colloid*, are too rare to require further notice in a work of this description.

EXCISION OF THE BREAST.—The arm being held out from the side by an assistant so as to put the pectoral muscle on the stretch and well expose the axilla, an elliptical incision should be made below and another above the nipple, cutting widely of any adherent or infiltrated skin. The skin above and below should now be reflected from the breast, and the latter dissected off the pectoral muscle, taking care to remove the pectoral fascia and any portion of the muscle that appears affected with the disease. Should any gland be felt in the axilla, the incision should be prolonged in an upward and outward direction, the axillary fascia opened by the scalpel, and all the glands that can be felt enucleated in part by the fingers, and in part by the handle of the scalpel, taking care not to injure the axillary vessels or large nerve-cords, both of which are situated at the upper and outer part of the space. The skin should now be drawn together by sutures, a drainage tube having been placed in the deeper part of the wound. Where the skin cannot be made to cover in the wound, the flaps should be drawn as much together as possible by stout silver sutures, and the remainder of the wound left to granulate. The arm should be secured to the side with the forearm and hand across the chest.

DEFORMITIES OF THE NECK, KNEES AND FEET.

WRY-NECK OR TORTICOLLIS is a distortion chiefly dependent upon contraction of the sterno-mastoid muscle. It may be congenital or acquired.

Causes.—The *congenital form* is attributed to—1, spastic contraction of the sterno-mastoid muscle due to disease of the nervous system; 2, malposition *in utero;* or, 3, injury at birth, as, for example, rupture of the sterno-mastoid in a breech presentation. The *acquired form* is due to—1, the head having been held for a long time in the distorted position as a consequence of stiff neck following cold, injury, or inflamed cervical glands; 2, hysteria; or, 3, spasm set up by irritation of the spinal accessory nerve consequent upon central nerve-trouble.

Signs.—The head, supposing the right sterno-mastoid to be affected, is drawn forwards and towards the right shoulder and also rotated, so that the chin points to the left. The right mastoid is prominent, the right side of the neck concave, and the left convex. In long-standing cases some lateral curvature of the dorsal spine is generally acquired. The congenital form may be distinguished from the spasmodic not only by its history but by the sterno-mastoid becoming tense in the former, and yielding in the latter, on attempting to straighten the head. The hysterical variety will be known by the presence of other signs of hysteria.

Treatment.—In *congenital wry-neck*, unless the patient is treated by position while still an infant, division of the sterno-mastoid is generally required, followed by a course of systematic exercises in the slighter cases, and the use of some such instrument as that shown in Fig. 285, in the more severe. The sterno-mastoid is best divided immediately above the clavicle, as here it is furthest removed from the important structures that lie beneath

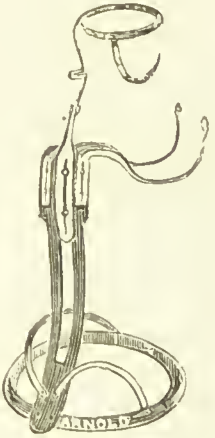


FIG. 285. — Wry-neck apparatus.

it. A puncture should be made at the inner side of the tendon, a director passed behind it, and the division made towards the skin with a blunt-pointed tenotome. The tense bands of contracted cervical fascia which now start forward will yield to stretching; it is not safe to divide them. The puncture should be given three or four days to heal before the exercises are begun or the instrument is applied. Some advise the division of the muscle about the middle on the plea that such is a more safe procedure. In *spasmodic* cases conium, Indian hemp, bromide of potassium, &c., may be tried. These failing, the spinal accessory nerve may be stretched or divided just above the spot where it enters the sterno-mastoid; but tenotomy of the sterno-mastoid should in these and in hysterical cases on no account be done. In the latter, hysterical remedies should of course be used.

KNOCK-KNEE OR GENU VALGUM is a deformity in which, when the knees are placed together in the extended position with the patellæ looking directly forwards, the legs diverge. One or both knees may be affected, or there may be genu valgum on one side and genu varum on the other.

Cause.—Knock-knee is generally the result either of rickets, when it occurs between the second and the seventh year; or of carrying heavy weights, long standing and the like, when it is most common in growing, underfed. and overworked lads and girls from fourteen to eighteen. The deformity is variously believed to depend on :—1, an overgrowth of the internal condyle of the femur, and a corresponding uprising of the inner tuberosity of the tibia; 2, the relaxation of the internal lateral ligament; or 3, the contraction of the biceps tendon. In the majority of cases the osseous lesion is certainly present, and I have no doubt in my own mind that it is upon this that the deformity in rickety cases usually depends, though I admit that in some of those rapid cases induced by excessive weight-bearing in weakly lads, a relaxation of the ligaments may be the principal factor. The contraction of the biceps tendon when present I regard as the result, and not as the cause, of the affection. *Treatment.*—In slight rickety cases keeping the child entirely off its legs, the application of splints, and the internal use of appropriate remedies, will generally effect a cure. In confirmed cases, and in older patients, however, little must be expected from splints or instruments. By their use the limb can no doubt be straightened, but only at the expense of stretching the external lateral ligament, the legs being rendered flail-like, and the patient being unable to walk or even stand without his irons. For such some form of osteotomy is usually required. The best of these is, perhaps, Macewen's and Reeves' modification of Ogston's operation. 1. *Macewen's operation* consists in chiselling through the femur just above the epiphysis, but leaving the posterior surface, which is in contact with the popliteal artery, intact, and snapping this across by forcibly bending the bone. 2. In *Reeves' modified Ogston's operation* the internal condyle is first loosened with a chisel, and then made to slide upwards on the shaft of the femur by forcibly straightening the leg. The chisel is introduced behind the synovial membrane and should not be driven sufficiently far into the condyle as to endanger the opening of the joint. The line of incision through tho femur in these operations is shewn in Fig. 286. The operations should be performed antiseptically and the limb secured to a long splint, or placed in Bavarian plaster splints in a straight position for about a month, and subsequently kept in an ordinary plaster case for six weeks to two months till sound union has taken place.

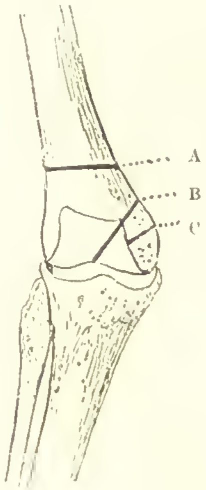


FIG. 286. — A, line of section in Macewen's; B, in Ogston's; and C, in Reeves' modified Ogston's operation.

GENU VARUM, or BOW-LEGS, is the opposite deformity to genu valgum, and what has been said of the latter as regards pathology, treatment, &c., will apply to it if external be substituted for internal in the phraseology. It is frequently associated with a bowing of the shaft of tho tibia, either at its upper or its lower third, and sometimes with a bowing of the femur.

TALIPES or CLUB-FOOT is a distortion in which the relations of the tarsal bones to each other and to the bones of the leg are variously altered, and the bones held in their abnormal position by the contraction or shortening of certain of the muscles, ligaments, and fasciæ attached to the foot.

Cause.—Talipes may be either congenital or acquired. The *congenital* form has been attributed to—1, spastic muscular contraction induced by some lesion of the nerve-centres; 2, malpositions of the fœtus *in utero;* 3, structural alteration in the form of some of the tarsal bones. The supporters of the first view maintain that the bones are drawn into their abnormal position by muscular contraction, and regard any alteration in the shape of the bones as the result and not as the cause of their malposition; whilst those who uphold the second and third views deny that spastic contraction occurs, as no lesion of the nerve-centres has been found to account for it, and look upon the contraction of the muscles as merely due to adaptive shortening consequent upon the altered position of the bones. The congenital variety is often hereditary, occurs in several members of the same family, and is frequently associated with other congenital malformations as spina bifida, meningocele, &c. The *acquired* form is generally the result of infantile paralysis, the bones being then drawn into their abnormal positions by the contraction of the muscles antagonistic to those paralysed, the weight of the body in standing and walking tending more and more to confirm this faulty position. Amongst other causes may be mentioned long-continuance of the foot in the extended position, disease of the ankle or tarsus, yielding of the ligaments, &c.

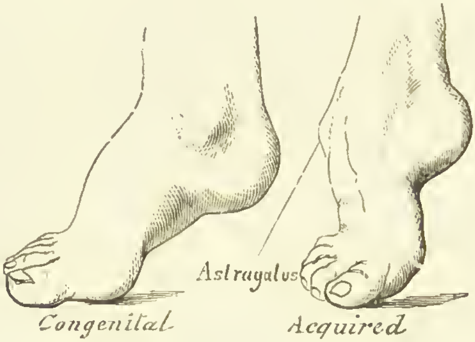


FIG. 287.—Talipes equinus. (Bryant's Surgery.)

Varieties.—There are five principal forms of club-foot:—*Talipes equinus, varus, calcaneus, valgus* and *cavus.* But these may be variously combined, producing compound forms, which are then called *equino-varus*, *equino-valgus*, *calcaneo-valgus*, &c.

1. In *talipes equinus* (Fig. 287), which is nearly always an acquired affection, the heel is drawn upwards by the tendo Achillis, and the anterior part of the foot is in consequence depressed and held in the extended position. The weight of the body is thus transmitted through the heads of the metatarsal bones, which together with the anterior part of the tarsus are bent downwards and backwards from the transverse tarsal joint and fixed in this position by the adaptive shortening of the plantar fascia, ligaments and muscles, thus rendering the sole of the foot unnaturally concave, a condition known as *pes cavus*. The patient walks with fatigue and lameness on the balls of his toes, and if both feet are affected he may be unable to walk at all. In long-standing cases, in consequence of the contraction being greater on the inner than on the outer side of the sole, an inward twist is given to the foot (*equino-varus*).

2. *Talipes varus* is the most complicated variety of club-foot, and is the most common of the congenital forms. By some the distortion here described as varus is called *equino-varus*. I prefer, however, to apply the simple term varus to the form under consideration, and equino-varus to cases of equinus, in which there is added a secondary twisting inwards of the foot. In varus (Fig. 288), the os calcis is drawn up by the tendo Achillis, tilting the astragalus partially out of the ankle-joint, and the bones in front of the transverse tarsal joint are drawn inwards and upwards by the tibialis anticus and posticus, so that the scaphoid is placed internal to the astragalus instead of in front of it, whilst its tuberosity is in close contact with the internal malleolus. The ligaments on the inner side of the sole and between the tibia and astragalus are shortened, and are often the chief agents holding the bones in their deformed position. In severe cases, however, the astragalus is itself deformed, its head looking almost inwards instead

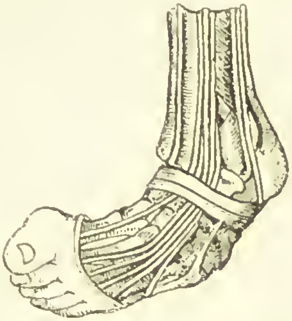


FIG. 288. — Congenital talipes varus. (St. Bartholomew's Hospital Museum.)

of forwards and slightly inwards. Thus, in a well-marked case (Fig. 289, A and B), the heel appears drawn up, the anterior part of the foot inverted, the inner border turned upwards, the outer border downwards, so that the sole looks backwards and the dorsum forwards, the long axis of the foot being at the same time shortened and bent upon itself, the sole unnaturally concave, and the plantar fascia tense. In severe cases (Fig. 289, C), the inner border may be in contact with the leg, and when the foot has been walked upon the sole looks upwards as well as backwards, and the dorsum downwards as well as forwards; whilst the sole is narrowed by the approximation of the fifth metatarsal bone to the first, and a bursa often forms over the outer border of the dorsum. In the *acquired form*, which is generally due to infantile paralysis, the history of the case, the wasting, shortening, and coldness of the limb, the general rounded appearance of the foot and often the absence of rigidity, will commonly serve to distinguish it from the congenital.

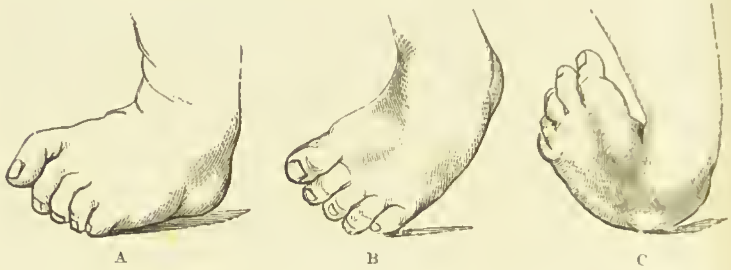


Fig. 289.—Congenital varus. Three grades of severity. (Bryant's Surgery.)

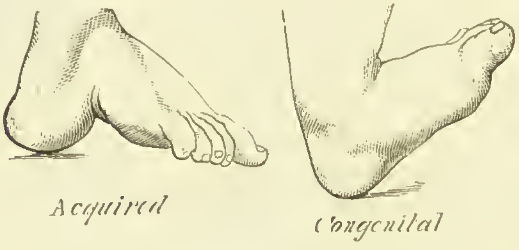


Fig. 290.—Talipes calcaneus. (Bryant's Surgery.)

3. *Talipes calcaneus* is rare. In the *congenital* variety (Fig. 290) the anterior part of the foot is drawn up and

often a little everted, and generally held rigidly in this position by the contraction of the extensor muscles. In the *acquired* form (Fig. 290), which is commonly the result of infantile paralysis of the calf muscles, the heel is placed first on the ground in walking, but there is no drawing up of the foot by the extensors. The anterior part of the foot drops downwards from the transverse tarsal joint, and the tendo Achillis instead of standing out tensely, can often hardly be felt.

4. In *talipes valgus or flat foot* the longitudinal and transverse arches of the foot are flattened and the anterior part of the foot is more or less everted. Though rare as a congenital, it is very common as an acquired deformity, and as such is, perhaps, most often due to the yielding of the ligaments of the sole and the relaxed state of the muscles which normally support the plantar arches, in consequence of general debility and want of muscular tone, combined with long standing or carrying heavy weights. Hence its frequency in growing and under-fed lads, errand-boys, policemen, waiters, housemaids, and the like. Amongst other causes may be mentioned rheumatism, rickets, sprains of the plantar ligaments, and spasm or paralysis of certain muscles of the leg. The calcaneo-scaphoid ligament and plantar fascia, and to a less extent the other ligaments of the sole, are elongated, and the bones on the inner side of the foot, instead of forming an arch, are depressed and in contact with the ground. The bones in front of the transverse tarsal joint are at the same time more or less everted, leaving the head of the

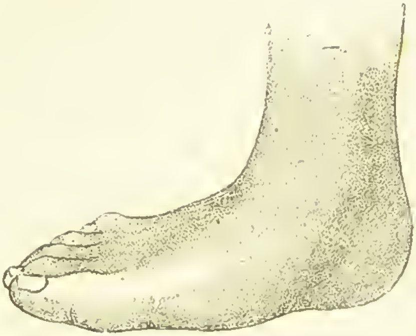


Fig. 291.—Talipes valgus or flat foot.
(St. Bartholomew's Hospital Museum.)

astragalus, which is itself depressed, partly exposed on the inner side of the foot.

In severe, and generally in congenital cases, the heel and front of the foot are drawn up by the tendo Achillis and the anterior muscles, whilst the outer border of the foot is raised from the ground. The acquired form is productive of so much crippling and pain as to render the sufferer unable to follow any employment which necessitates much standing or walking. The foot (Fig. 291) looks broader and longer than natural, the sole is flat, the inner border in contact with the ground, and the internal malleolus depressed; whilst two prominences, formed by the tuberosity of the scaphoid and the partially exposed head of the astragalus, can be seen and felt projecting on the inner side of the foot. In slight cases the foot can be made to assume its natural form on manipulation or on standing on tip-toe, but in severe cases it is rigidly fixed in the deformed position.

GENERAL TREATMENT OF TALIPES.—The indications are—1, to restore the deformed foot to its natural position; and 2, to retain it in this position until the normal functions of the joints and muscles have been so far restored that there is no tendency to a relapse. In the congenital and in many of the acquired forms these indications can be successfully fulfilled if appropriate means are taken and sufficient time and care are given to the case. But in the paralytic varieties, where the muscles have undergone complete atrophy and degeneration, these, of course, cannot be restored, and the foot can only be maintained in the normal position by the use of instruments. For the fulfilling of the first indication, both operative and mechanical or manipulative treatment may be necessary. For the second, the use of mechanical supports and physiological after-treatment should be employed.

The *operative treatment*, when this is necessary, will generally consist in the subcutaneous division of certain tendons (*tenotomy*), in the division of contracted ligaments (*syndesmotomy*), and in inveterate cases in the excision or section of some of the tarsal bones (*tarsectomy* or *tarsotomy*).

Tenotomy is indicated where there is much rigidity and the foot cannot be brought into its natural position by manipulation. Its object is the lengthening of the shortened tendon, not its mere division. The lengthening is effected by the organization of the small-cell-exudation which is poured out between the divided ends of the tendon. Hence the importance of subcutaneous division, that is, of making a mere puncture in the skin and preventing the entrance of air lest suppuration ensue and the tendon become adherent to its sheath and fail to unite. The tendon having been made tense by an assistant, pass the tenotome beneath it with the blade on the flat; and then whilst the tendon is slightly relaxed, turn the edge of the tenotome towards the tendon and cut towards the skin, the assistant again making it tense to facilitate the division, but relaxing the moment it is felt to give way lest the skin be severed and the puncture be converted into an open wound. The puncture should be covered with a dossil of oiled lint, and the foot secured to a splint or in a plaster-of-Paris bandage. It was formerly the custom to place the foot in the deformed, or in only a slightly improved position for a few days until the puncture had healed and the tendon had united before beginning mechanical extension to stretch the new material between the divided ends. It was thought that if tho foot was at once rectified and the ends of the divided tendon consequently much separated, there was grave risk of the tendon not uniting, or of the uniting material remaining weak. I have not, however, found this to be the case, and I now invariably place the foot immediately after tenotomy in the best position possible, often leaving a gap of half-an-inch to an inch or even more between the ends of the divided tendon. By at once rectifying the position of the foot, after dividing any contracted ligaments that may still hold the bones in their deformed position, much time is saved and the necessity of expensive extension apparatus is avoided. In dividing the posterior tibial tendon, after a puncture has been made with a sharp-pointed tenotome, a blunt tenotome should be substituted for it lest the posterior tibial artery bo pricked. Should this vessel be wounded, all that is necessary is to apply firm pressure to the foot and ankle by a pad and bandage. On no account should an attempt be made to tie it, as this would convert the subcutaneous into an open wound. Even where the anterior as well as the posterior tibial artery has been wounded in tenotomy, bleeding has been readily arrested by pressure, and no harm has ensued. In the fat ankle of an infant the posterior border of the tibia, the guide to the tendon of the tibialis posticus, cannot be felt; the tenotome should then be entered midway between the anterior and posterior border of the leg, and at right angles to the surface.

Syndesmotomy consists in dividing the contracted ligaments which, after tenotomy, are frequently found to hold the foot in the deformed position. It is performed by passing a tenotome deeply into the foot over the situation of the ligaments to be divided, and cutting freely through them whilst they are put on the stretch by an assistant manipulating the foot. The position of the foot should then be rectified by wrenching, and a plaster-of-Paris bandage applied.

Tarsectomy has for its object the removal of certain bones or portions of bones from the tarsus, so as to allow the foot to be at once restored to its normal position. It should only be undertaken in inveterate cases after milder measures have failed. The operations most frequently performed are Davy's, or the removal of a wedge-shaped piece of bone from the tarsus; and Lund's, or the excision of the astragalus.

Tarsotomy is the operation of dividing the tarsus transversely with a chain saw, and, like tarsectomy, should only be done in inveterate cases.

Mechanical treatment.—Until recently it was usual to keep the foot in the deformed position till the tendon had united, and then bring the foot slowly into its normal position by gradually stretching the divided tendon. The apparatus usually employed was some form of Scarpa's shoe (Fig. 292) or other cog-wheel contrivance. By the majority of Surgeons, however, plaster-of-Paris is now substituted for such expensive apparatus, the foot being secured at once in the plaster in the best possible position. In slight cases division of the tendon will alone be sufficient to allow of this; in more severe cases the division of the ligaments will also be necessary, whilst in very severe cases removal of a portion of bone will be required. If plaster-of-Paris is used a cotton-wool bandage should always be employed beneath the plaster to prevent injurious pressure on the parts. The mechanical supports necessary after the foot has been rectified will be briefly

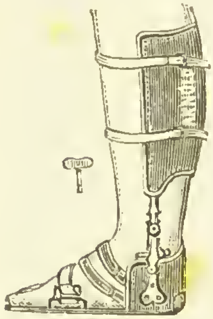


FIG. 292. — Scarpa's shoe.

mentioned under the treatment of each variety of talipes.

Physiological after-treatment is most important for the purpose of restoring the natural movements of the joints and the functional activity of the muscles. It consists in active and passive exercises, shampooing, Faradization, hot and cold sponging, and lastly in teaching the patient the proper use of the restored foot.

It now remains to mention the special treatment appropriate to each variety of talipes.

In *talipes equinus*, tenotomy of the tendo Achillis is usually all that is required; but if there is much contraction of the sole, the plantar fascia, or any tense band that can be felt, should first be divided, and when the sole has been straightened out by keeping the foot for a fortnight or so in plaster-of-Paris, the tendo Achillis may then be cut, and the foot again placed in plaster in the restored position for another two or three weeks. A boot with double leg-irons and toe-raising spring must be subsequently worn in paralytic cases, the irons being carried above the knee and the outer iron above the hip to a pelvic band if the flexors or extensors of the leg are also affected (Fig. 293).

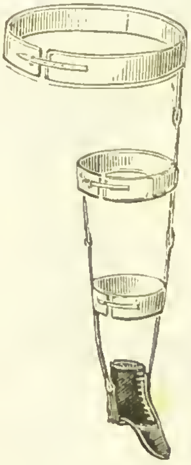


FIG. 293.—Boot with double leg-irons to above knee, outside iron continued to pelvic girdle.

In *talipes varus*, except in slight cases, the tibialis anticus and posticus should first be divided, and the inversion of the foot overcome by some form of varus splint, or plaster-of-Paris. When this has been thoroughly done, the tendo Achillis should be cut, and the heel brought down as in *equinus*. Where there is much contraction of the sole, the plantar fascia, or other tense band, should be divided after the tibials but before the tendo Achillis. A similar instrument to that described for equinus should then be worn for six months to a year or more; or as long as any tendency is shewn to relapse. In paralytic cases, where the whole leg tends to twist inwards from the hip-joint, the outer iron should be carried to the pelvis. In very severe cases the ligaments on the inner side of the sole and the posterior ligament of the anklo may be divided subcutaneously, as suggested by Mr. R. W. Parker (*syndesmotomy*); or, if this is not enough, the whole of the soft tissues in the inner side of the sole may be divided subcutaneously down to the bone (*Buchanan's operation*), or the contracted tendons and ligaments below and in front of the internal malleolus may be divided by an open incision (*Phelps' operation*), or as a last resource a wedge-shaped piece of the transverse tarsal joint, or the astragalus, may be removed.

In *talipes calcaneus*, the extensor tendons, in the congenital form, must be divided if the foot cannot be rectified by plaster-of-Paris alone. In the acquired form, a boot and irons, similar to that used in equinus but with a toe-depressing spring, may be worn. In paralytic cases the tendo Achillis may in some instances be shortened by removing half an inch or more and splicing the divided ends.

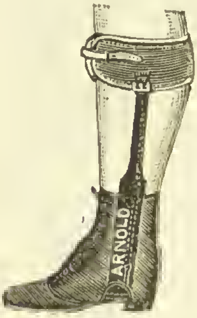


FIG. 294.—Author's boot for flat foot.

In *talipes valgus* or *flat foot*, such exercises as alternately raising the body on tip-toe, or walking on the outer edge of the foot, will in slight cases of the acquired variety when combined with the use of a valgus pad, and a properly shaped boot, generally be successful. In severer cases a boot with outside leg-iron and rubber band to brace up the sunken arch (Fig. 294), should be worn; whilst, where there is much rigidity, the foot should be wrenched into position with the patient under an anæsthetic and placed in plaster-of-Paris for a month. The wrenching may be repeated if necessary, and the boot above described subsequently worn. In very severe cases excision of Chopart's joint, and removal of a wedge-shaped piece of the neck of the astragalus, have been performed, and are said to be attended with success. I have never had occasion to do either operation, having always found wrenching sufficient. By some Surgeons, division of the peronei tendons is recommended, a procedure which in my opinion is quite unnecessary, and contrary to the principles which should guide us in the treatment of the deformity.

APPENDIX.

AMPUTATIONS.

AMPUTATIONS.—The objects that should be kept in view in performing an amputation are:—1, to remove the whole of the injured or diseased part that is beyond the reach of recovery, with as little sacrifice of the healthy tissues as possible; 2, to prevent all unnecessary hæmorrhage; 3, to secure a sufficient covering for the end of the bone; 4, to avoid adhesion of the cicatrix to the bone; 5, to divide the large blood-vessels and nerves transversely, and leave their cut ends in such a part of the stump that they may be little exposed to pressure; and 6, to ensure an efficient drain and aseptic condition of the wound.

Amputations may be performed by the *circular* or by the *flap* method.

In the *circular method* the integuments are first divided by a circular incision round the entire circumference of the limb. They are then retracted, and the muscles divided higher up the limb by a similar circular sweep of the knife. The muscles are next in their turn retracted, and the periosteum is divided still higher up the bone, which is finally sawn through at that spot. This method possesses the advantages that the vessels and nerves are divided transversely, and that the wound is of moderate dimensions; but the cicatrix is opposite the end of the bone, the coverings for the latter are apt to be deficient, and the stump is liable to assume a conical shape. The circular method is now seldom employed, except, perhaps, for amputation of the arm.

In the *flap method*, double flaps, or a single anterior or posterior flap, are provided for the covering of the bone. The flap or flaps may consist of integuments alone, or of more or less of the muscular and other soft tissues as well. In the former case the flaps are cut and reflected, and the muscles and other soft parts are then divided at the level of the base of the flaps in a circular manner down to the bone, which is sawn through a little higher up. By this method most of the advantages of the circular amputation are secured without its disadvantages. When, on the other hand, the muscles are included in the flaps, the vessels and nerves are liable to be split, or notched, or divided obliquely instead of transversely, whilst the mass of muscle in the flap tends to prolong the healing of the wound. These muscular flaps may be cut either from without inwards, *i.e.*, from the circumference towards the bone, or from within outwards, *i.e.*, by the method of transfixion. In whichever way the flaps are cut, and whether they consist of integuments only, or of integuments and muscle, they may as regards position be antero-posterior or lateral, or one may be antero-external, and the other postero-internal, or *vice versâ*. As regards length they may be equal, or one may be long, the other short; and as regards breadth they should be half the circumference of the limb. As a rule they should be cut square, but with rounded angles. The following modifications of the flap operation may be briefly mentioned.

Teale's method consists in making a long and a short rectangular flap. The long flap, which is generally anterior, or antero-external, is quadrilateral in shape, and its length and breadth each equal to half the circumference of the limb; it includes all the soft parts down to the bone. The short flap is posterior, or postero-internal: its length is one-fourth the anterior, and its breadth equal to half the circumference of the limb; it also includes all the soft parts down to the bone, and contains the large vessels and nerves. The advantages claimed for Teale's method are:—1, freedom from tension; 2, a complete covering for the bone free of large vessels and nerves; and 3, a dependent position of the wound. It is applicable to amputations through the leg and lower third of the thigh.

Carden's method, designed for amputating through the condyles of the femur, consists in reflecting a semi-oval flap of integuments, half the circumference of the limb in length and breadth, from the front of the knee-joint, dividing everything else down to the bone by a circular sweep of the knife, and sawing the bone slightly above the plane of the divided muscles.

SPECIAL AMPUTATIONS.—*Amputation at the shoulder-joint* may be performed either by the flap or by the oval method. In either case the subclavian artery should be compressed above the clavicle, or in some instances the axillary tied before the amputation is begun. *The flap* *method.*—A large flap consisting of integuments and deltoid muscle, is usually taken from the outer aspect of the joint, either by transfixion or better by cutting from without inwards. In *transfixion*, the deltoid having been grasped and raised by the surgeon's left hand the knife should be made to transfix the limb on its upper and outer aspect just below the acromion, and a flap formed with rounded angles about four inches long. The flap is turned back, the head of the bone freed from its connections, and the knife passed behind it, and made to cut its way out towards the axilla, the axillary artery being seized as it is divided. In cutting a flap from *without inwards*, the incision is made from a point just external to the coracoid process and carried in a circular sweep downwards as low as the insertion of the deltoid, and then upwards to the posterior fold of the axilla just behind and below the acromion. In the *oval* method an incision is made from the acromion vertically downwards for about two inches as in excising the joint, and is then carried in an oval manner round the arm, forming two flaps. The outer flap is next dissected up, the head freed from its connections, and the knife passed behind the bone and made to cut its way out as in the other methods, the axillary artery being divided last of all.

Amputations of the arm and forearm are usually performed by double skin-flaps and circular division of the muscles. The circular method, however, or amputation by single or double transfixion or by Teale's method may be employed.

Amputation at the wrist may be performed by two short flaps, by a long palmar flap, or by an external flap taken from the thumb. In the double flap method the incision is commenced half an inch above the styloid process of the radius or ulna. The flaps should be cut square, with rounded angles, and about two inches in length. The joint should be opened on the dorsal aspect, and on the completion of the disarticulation the styloid processes of the radius and ulna sawn off.

The *thumb* at the carpo-metacarpal joint may be amputated by transfixion or by an oval incision. In the *transfixion* method the point of the knife in operating on the right side is entered at the web of skin between the first and second metacarpal bones, and made to emerge on the palmar aspect of the carpo-metacarpal joint. A palmar flap is then cut from the tissues forming the ball of the thumb, and the knife drawn obliquely across the back of the thumb from one extremity of the flap to the other. In operating on the left side, the oblique incision across the back of the thumb is first made, then the point of the knife is thrust down through the web and made to transfix as on the right side. In the *oval or circular* method, the knife is entered mid-way between the base of the metacarpal bone and the styloid process of the radius, and the incision carried obliquely along the dorsum of the metacarpal bone to the first phalanx, and then round the palmar surface and back again to the former incision.

The *fingers* may be amputated by double flaps or by a long anterior flap. In amputating a finger it should be remembered that the joint is in front of the knuckle. If the whole finger requires removal, the head of the metacarpal bone should be nipped off with bone forceps, unless breadth and strength of hand is the chief desideratum, when it should be left.

Amputation at the hip-joint may be done by transfixion or by Furneaux Jordan's method. Although the former can be performed with greater celerity, the latter is by far the better operation, as it is attended with less hæmorrhage and provides a much more useful stump. In the *transfixion method* a long anterior flap is made by transfixing and cutting from within outwards. The knife is entered mid-way between the anterior superior iliac spine and the great trochanter, and is made to emerge as near to the tuberosity of the ischium as possible. A flap about ten inches long is then cut, the vessels being seized by the fingers of an assistant, who grasps them with the flap and turns it upwards. The limb is then everted and extended by an assistant, the joint opened, the head of the bone and great trochanter freed from their connections, and the knife carried straight out posteriorly. Hæmorrhage should be controlled by Davy's lever in the rectum, or by Lister's abdominal tourniquet. In *Furneaux Jordan's method*, Esmarch's cord tourniquet having been applied, a circular amputation is first done through the upper third of the thigh, and all the vessels secured. The tourniquet is then removed and an incision carried up the outer side of the thigh to the great trochanter, the soft parts with the periosteum separated from the bone, the joint opened, and the disarticulation completed by freeing the remaining connections with the knife kept close to the bone.

Amputation of the thigh is usually done by double skin-flaps and circular division of the muscles. The flaps may be antero-posterior, or lateral; or one flap may be antero-external and the other postero-internal.

Amputation of the leg may also be done by two skin-flaps and circular division of the muscles, or by Teale's method. The posterior flap is sometimes cut by transfixion. The sharp edge of the tibia should be cut off obliquely, lest it subsequently protrude through the skin. The division of the fibula should be completed before that of the tibia to prevent splintering. Should the arteries retract, as they are apt to do in this situation, they may be conveniently drawn down by a tenaculum.

Amputation of the foot may be done by one of the following methods:—

Disarticulation at the ankle-joint (*Syme's amputation*) consists in removing the foot at the ankle-joint, cutting off the ends of the tibia and fibula, and retaining the integuments of the heel as a covering for the bones. An incision down to the bone is made across the under surface of the heel from the tip of the external malleolus to a little behind and below the internal malleolus; *i.e.*, to a point exactly opposite its commencement. This incision should incline slightly backwards, so as to cross the os calcis just in front of the tubercles. A second incision is next made across the front of the ankle, the joint opened, the lateral ligaments divided, and the os calcis cleared from its posterior and lateral connections by cutting from above downwards. Syme, however, formed his heel-flap by dissecting it from the bone from below upwards, a more difficult procedure than cutting from above downwards as is now always done at St. Bartholomew's. The knife should be kept close to the bone to avoid injuring the posterior tibial artery or button-holing the integuments. The malleoli and a thin slice of the tibia are finally sawn off. The anterior tibial and the plantar arteries require ligaturing; the latter are situated at the extremity of the inner side of the heel-flap.

Pirogoff's operation is a modification of Syme's. It differs in that the posterior part of the os calcis is left in the heel-flap to unite with the sawn end of the tibia. It is performed in a similar manner, save that the sole-incision is carried slightly forward instead of backward; and after the ankle-joint is opened, and the os calcis exposed, the posterior part of the latter is sawn off instead of being dissected out. The sawn surface of the os calcis is then turned up and placed in contact with the sawn end of the tibia, to which it may advantageously be fixed by an ivory peg driven through the heel-flap and os calcis into the lower end of the tibia.

The *Medio-tarsal amputation* (*Chopart's*) consists in amputation of part of the foot through the transverse tarsal joint, *i.e.*, the joint formed by the os calcis and astragalus behind, and the cuboid and scaphoid in front. A curved incision with its convexity forwards is made across the dorsum of the foot from immediately behind the tubercle of the scaphoid to a point midway between the tip of the external malleolus and the base of the fifth metatarsal bone. The extremities of this incision are connected by tracing out from the sole a flap which should reach just short of the balls of the toes, and should be longer on its inner than on its outer side. The dorsal ligaments are now divided, and the knife is passed beneath the bones and made to cut its way outwards, thus completing the flap already marked out on the sole. The astragalus and os calcis are, of course, left in the stump. The chief objection that has been urged against the operation is the tendency of the tendo Achillis to draw up the os calcis, and consequently so depress the anterior part of the stump that the cicatrix becomes the lowest part. If care, however, is taken to make the dorsal incision nearly straight across the foot, this drawing up of the heel can to a great extent be prevented and an excellent and useful stump may be obtained.

Amputation of the metatarsus consists in removing the anterior part of the foot at the joints between the tarsus and metatarsus, leaving the tarsus intact. It may be done—1, by disarticulating the metatarsal bones; 2, by sawing across the bases of all the metatarsal bones; 3, by disarticulating the four outer metatarsal bones and sawing across the projecting internal cuneiform bone; 4, by disarticulating the three outer and the first metatarsal bones, and sawing across the prominent base of the second. The disarticulating method is usually called Lisfanc's operation; the disarticulating, with sawing across the internal cuneiform or base of the second metatarsal bone, Hey's. Hey however, it appears, performed all of the first three operations, but not the last; and so much confusion has arisen as regards what is meant by Lisfanc's and what by Hey's operation that the terms had better be dropped. In the disarticulating method, which only need be described, an incision is made across the tarsus from the fifth metatarsal bone to an inch in front of the prominence of the scaphoid; a sole-flap is next traced out, as in Chopart's amputation, but it should reach as far as the web of the toes. The metatarsus is then disarticulated from the tarsus, the only difficulty in doing this arising from the second metatarsal bone dipping in between the cuneiform bones. The knife is now placed behind the bones and made to cut its way out, thus completing the sole-flap.

The *great toe* may be amputated at its tarso-metatarsal joint by a flap taken from the inner side of the foot; or by an oval incision which is carried along the metatarsal bone to about the middle of its shaft, then made to diverge to the web between the first and second toes, and carried round the plantar surface of the big toe and back to the spot at the middle of the metatarsal bone. The incision should extend down to the bone, which should be next freed from its remaining connections and disarticulated, the knife being kept close to the metatarsal bone to avoid injuring the communicating branch of the dorsalis pedis with the external plantar artery. When the operation is completed merely a single longitudinal scar remains on the inner side of the foot.

INDEX.

BDOMEN, abscess of, 383
— contusions of, 382
— injuries of, 382
— protrusion of viscera of, 390, 391
— rupture of muscles of, 383
— — viscera of, 384
— tapping of, 623
— wounds of, 385
bdominal parietes, abscess of, 383
— — wounds of, 385
— viscera, wounds of, 391
— — protrusion of, 390, 391
— — rupture of, 384
bscess, 17
— acute, 18
— alveolar, 540
— anal, 665
— anatomy of, 19
— of bone, 216
— of brain, 350, 469, 481
— of breast, 777
— causes of, 21
— chronic, 22
— cold, 22
— complication of, 22
— fæcal, 633
— Hilton's method of opening, 22
— iliac, 597
— ischio-rectal, 665
— of kidney, 675
— lachrymal, 491
— lumbar, 596
— mediastinal, 376
— metastatic, 148
— of muscle, 258
— of orbit, 508
— perinæal, 732
— perinephritic, 675
— postpharyngeal, 562
— of prostate, 710
— psoas, 596
— residual, 23
Abscess, spinal, 596
— symptoms of, 21
— termination of, 23
— of tongue, 524
— treatment of, 21, 23
— urinary, 732
Acetabulum, fracture of, 394
Acinous carcinoma, 80
Acne rosacea, 548
Acromion, fracture of, 421
Actual cautery in hæmorrhage, 119
Acupressure in hæmorrhage, 122
Adenoid vegetations, 560
Adenoma, 70
— acinous, 71
— of breast, 780
— cystic, 71
— tubular, 71
Adeno-fibroma, 71, 780
— -sarcoma, 781
Air in veins, 194
Air-passages, foreign bodies in, 365
— operations on, 574
— wounds of, 359
Alveolar abscess, 540
Ambiyopia, toxic, 504
Amputations, 801
Amussat's operation, 619
Anal abscess, 665
— ulcer, 658
Anel's operation, 285
Aneurism, 268
— by anastomosis, 312
— arterio-venous, 192
— of bone, 231
— causes of, 268
— circumscribed, 271
— cirsoid, 312
— classification of, 270
— contents of, 270
— diagnosis of, 275
— diffused, 271

Aneurism, dissecting, 271
— effects of, 273
— false, 271
— formation of, 269
— fusiform, 271
— galvano-puncture in, 286
— ligature in, 280
— manipulation in, 286
— pressure in, 277
— rupture of, 273
— sacculated, 271
— signs of, 273
— special, 286
— sphygmograph in, 274
— spontaneous, 268
— structure of, 269
— suppuration of, 272, 284
— terminations of, 272
— traumatic, 191
— treatment of, 275
— true, 271
Aneurisms, aortic, 287
— axillary, 289
— carotid, 288
— femoral, 291
— gluteal, 289
— inguinal, 290
— internal, 287
— in neck, 287
— orbital, 288
— popliteal, 291
Aneurismal varix, 192
Angioma, 69, 310
Angular curvature of spine, 597
Ankle, amputation at, 805
— dislocation of, 445
— excision of, 257
— sprains of, 432
Ankyloglossia, 523
Ankylosis, bony, 251
— fibrous, 251
Annular stricture, 669
Anthrax bacillus, 144
Antiseptic treatment of wounds, 100
Antrum, abscess of, 541
— cysts of, 543
— diseases of, 543
— tumours of, 543
Antyllus, operation of, for aneurism, 285
Anus, artificial, 643
— diseases of, 657
— fistula of, 666
— imperforate, 657
Anus, painful ulcer of, 658
— prolapse of, 659
— pruritus of, 658
Aorta, aneurism of, 287
Aphasia after head injury, 346
Aphthous stomatitis, 520
Arch, palmar, wounds of, 403
Argyll-Robertson test, 249, 514
Arm, amputation of, 803
Arterial varix, 312
Arteries, atheroma of, 265
— calcification of, 267
— contusions of, 185
— diseases of, 264
— fatty degeneration of, 267
— injuries of, 185
— laceration of, 185
— ligature of, 189, 292
— repair of wounds of, 115
— rupture of, 185
— syphilitic disease of, 267
— torsion of, 121
— treatment of wounds of, 188
— wounds of, 187
Arterio-venous aneurism, 192
Arteritis, 264
— plastic, 116, 265
— obliterative, 267
— septic, 264
— suppurative, 264
— syphilitic, 267
Artery forceps, 120
Arthrectomy, 253
Arthritis, acute, 236
— chronic strumous, 239
— — rheumatoid, 245
— osteo-, 245
Artificial anus, 643
Aspiration in abscess, 23
— of bladder, 741
— of kidney, 679
Astigmatism, 511
Astragalus, dislocation of, 446
— fracture of, 465
Atheroma, 265
Atlo-axoid disease, 600
Atony of bladder, 690
Atrophy of bone, 218
— — muscle, 258
— — testicle, 765
Auditory vertigo, 483
Aural exostosis, 476
— forceps, 470, 475
— polypi, 479
— specula, 470

Aveling's transfusion apparatus, 114
xillary aneurism, 289
— artery, ligature of, 297

BACILLUS, 8
— anthracis, 144
— of tubercle, 44
Back, injuries of, 368
— sprains of, 368
Bacterium termo, 8
Baker's, Morrant, operation on tongue, 531
— tracheotomy tube, 578
Balanitis, 716
Bands, strangulation by, 605, 612, 617
Bank's operation for hernia, 629
Base of skull, fracture of, 336
Battey's operation, 775
Bedsores in spinal injuries, 372
Bellocq's sound, 550
Biceps tendon, rupture of, 402
Bladder, aspiration of, 741
— atony of, 690
— calculus of, 692
— cancer of, 691
— diseases of, 686
— extroversion of, 686
— foreign bodies in, 399, 402
— inflammation of, 688
— irritability of, 689
— malformations of, 686
— paralysis of, 690
— puncture of, 740
— rupture of, 394
— sacculated, 689
— in spinal injuries, 371
— stone in, 692
— in stricture, 689
— tubercular disease of, 691
— tumours of, 691
— ulceration of, 687
Blepharospasm, 490
Blood, transfusion of, 113
Blood-tumours of scalp, 328
Blood-vessels, diseases of, 264, 303
— injuries of, 185, 193, 378
Boils, 322
Bone, abscess of, 216
— atrophy of, 218
— cancer of, 230
— caries of, 209
— cysts in, 231
Bone, diseases of, 200
— fracture of, 157
— hypertrophy of, 218
— inflammation of, 200
— injuries of, 157
— mollities ossium, 222
— necrosis of, 211
— pulsatile tumours of, 229
— rickets in, 219
— sarcoma of, 227
— sclerosis of, 207
— struma of, 219
— syphilis of, 219
— tubercle of, 219
— tumours of, 224
Bow-legs, 791
Bowel (*see* INTESTINES).
Brachial artery, aneurism of, 289
— ligature of, 297
Brain, abscess of, 350, 469
— compression of, 340
— concussion of, 338
— contusion of, 344
— extravasation of blood on, 342
— injuries of, 338
— inflammation of, 348
— irritation of, 345
— hernia of, 351
— laceration of, 344
— suppuration in, 350
— topography of, 347
Brasdor's operation, 281, 285
Breast, abscess of, 777
— adenoma of, 780
— adeno-fibroma of, 780
— adeno-sarcoma of, 781
— cancer of, 784, 788
— cysts of, 783
— cysto-sarcoma of, 782
— chronic mammary glandular tumour of, 780
— diseases of, 776
— excision of, 788
— galactocele in, 783
— inflammation of, 776
— lobular induration of, 778
— neuralgia of, 776
— sarcoma of, 781
— tumours of, 779
Broad ligament, cysts of, 771
Bronchocele, 586
Bruises, 107
Bryant's line, 435, 451
— splint, 454

Bubo, 50, 717
Bunion, 264
Burns and scalds, 108
  — degrees of, 108
  — treatment of, 110
Bursæ, diseases of, 263
  — patellæ, 246
  — semi-membranosus, 264
Bursitis, 263

Calculus of bladder, 692
  — in female bladder, 706
  — of kidney, 676
  — of prostate, 713
  — salivary, 522
  — in urethra, 735
  — urinary, 681, 684
Calculous pyelitis, 676
Callaway's test for dislocated shoulder, 407
Callisen's operation, 619
Callous ulcers, 32
Callus, 161
Cancellous exostoses, 225
Cancer (*see* Carcinoma).
Cancrum oris, 521
Carbolized ligatures, 120
Carbuncle, 323
Carcinoma, 78
  — acinous, 80
  — adenoid, 84
  — of bladder, 691
  — of breast, 784
  — of bone, 230
  — colloid, 82
  — columnar-celled, 84
  — dissemination of, 79
  — encephaloid, 71
  — epithelial, 82
  — hard, 80
  — of jaw, 541
  — of lip, 515
  — medullary, 81
  — of nose, 548
  — of œsophagus, 563
  — of penis, 746
  — of rectum, 670
  — rodent, 520
  — scirrhous, 80
  — of scrotum, 747
  — soft, 81
  — spheroidal-celled, 80
  — squamous-celled, 83
  — of testicle, 763
  — of tongue, 528
Carcinoma, of tonsil, 539
  — treatment of, 84
  — varieties of, 79
  — of vulva, 767
Caries, 209
  — of skull, 467
  — of vertebræ, 594
Carotid aneurism, 288
  — artery, ligature of, 293
Carpus, dislocation of, 416
  — fracture of, 431
Cartilaginous tumours, 66
Castration, 765
Cataract, 500
Catarrh, chronic nasal, 551
  — of bladder, 687
  — of ear, 476, 479, 481
  — Eustachian, 471
Catheters, passage of, 721
Cautery, in hæmorrhage, 119
Cellulitis, 141
Cephalhæmatoma, 328
Cerebro-spinal fluid, 337
Cerumen in ear, 475
Cervical vertebræ, disease of, 594
Chalazion, 489
Chancre, 49, 744
Charbon, 143
Charcot's joint disease, 248
Cheeks, diseases of, 514
Chest, contusions of, 374
  — injuries of, 374
  — operations on, 381
  — wounds of, 374
Chilblains, 321
Cholecystectomy, 623
Cholecystotomy, 623
Chordee, 716
Choroiditis, 498
Cicatrices, diseases of, 28, 107
Ciliary blepharitis, 489
Circumcision, 743
Cirsoid aneurism, 312
Clavicle, dislocation of, 403
  — fracture of, 418
Clavus, 321
Cleft palate, 533
Cline's splints, 462
Cloacæ in bone, 214
Clove-hitch, 410
Club-foot, 791
Cock's operation for stricture, 731
Cold abscess, 22
  — in inflammation, 13
  — in hæmorrhage, 118

Collapse (*see* Shock).
Collateral circulation, 296
Colles' fracture, 428
Colloid cancer, 82
Coloboma, 490, 497
Colotomy, 619
Comminuted fracture, 157
Common carotid artery, ligature of, 293
Compound dislocation, 180
— fracture, 168
Compression in aneurism, 277
— of brain, 340
Concussion of brain, 338
— of spinal cord, 374
Condylomata, 51
Congenital dislocations, 180, 701
— hernia, 645
— syphilis, 56
Conjunctiva, diseases of, 491
— wounds of, 493
Connective-tissue tumours, 64
Continuous suture, 100
Contraction, Dupuytren's, 262
Contractions in intestinal obstruction, 608, 613
Contrecoup, fracture by, 331
Contusions, 107
— of arteries, 185
— of brain, 344
— of chest, 374
— of face, 353
— of joints, 174
— of larynx, 361
— of muscles, 183
— of nerves, 199
— of scalp, 330
Convulsions in head injuries, 343, 346
Convulsive tic, 319
Coracoid process, fracture of, 422
Cord, spinal, injuries of, 369, 370, 374
Coredialysis, 497
Cornea, diseases of, 493
Corns, 321
Coronoid process of jaw, fracture of, 356
— of ulna, fracture of, 431
Coryza, 551
Cowperitis, 716
Cranial nerves, injuries of, 338
Cranio-tabes, 58
Cranium (*see* Skull).
Crepitus, 159
Croup, 570
Crutch-palsy, 173
Curvature of spine, angular, 597
— — lateral, 589
Cut throat, 359
Cyclitis, 498
Cycloplegia, 514
Cylindrical carcinoma, 84
Cystic disease of breast, 783
— — kidney, 678
— — ovary, 771
— — testis, 764
Cystitis, acute, 687
— chronic, 688
Cystitome, 502
Cystocele, 707
Cysts, 85
— atheromatous, 86
— in bone, 231
— blood, 87
— congenital, 88
— dentigerous, 543
— dermoid, 89, 523
— extravasation, 87
— exudation, 85
— hydatid, 88
— Meibomian, 489
— mucous, 85
— parasitic, 88
— proliferous, 88
— retention, 85
— sebaceous, 86
— serous, 87

Deformities of nose, 559
— of feet, 789
Delirium, traumatic, 130
— tremens, 130
Dentigerous cysts, 543
Deposits, urinary, 681
Depressed fracture of skull, 332
Dermoid cysts, 89, 523
Diaphragmatic hernia, 656
Diathesis, strumous, 45
— hæmorrhagic, 59
Diffused aneurism, 271
Dilatation of stricture, 724, 725
Diphtheria, laryngeal, 570
Direct inguinal hernia, 647
Dislocations, 176
— causes of, 176
— extension in, 178
— symptoms of, 176
— manipulation in, 178
— compound, 178

Dislocations, treatment of, 178, 180
— congenital, 180
— special (*see* SPECIAL REGIONS).
— unreduced, 177
— varieties, 176
Displaced hernia, 641
Dissecting aneurism, 271
Dissection-wounds, 104
Distal ligature, 285
Dorsalis pedis artery, ligature of, 302
Dorsum ilii, dislocation on, 434
Douche, nasal, 554
Drainage tube, 98
Drill-bone, 259
Dugas' test for dislocation of humerus, 407
Duodenostomy, 624
Dupuytren's contraction, 262
— splint, 464
Dura mater, blood beneath, 342
— fungus of, 468
— inflammation of, 348

EAR, bleeding from, in fractured skull, 337
— catarrh of, 476, 477
— cerumen in, 475
— diseases of, 469
— examination of, 469
— foreign bodies in, 354
— wax in, 475
Ectopia vesicæ, 686
Ectropion, 490
Eczematous ulcer, 32
Elbow joint, dislocation of, 413
— excision of, 255
Electrolysis in aneurism, 276
— in nævus, 312
— in stricture, 731
Elephantiasis scroti, 748
— of the labium, 768
Embolic abscesses, 149
Embolism, fat, 173
Emmetropia, 510
Emphysema, surgical, 380
Encephalitis, 348
Encephalocele, 467
Encephaloid cancer, 81
Enchondroma, 66, 226
Encysted hernia, 646
— hydrocele, 751, 752
Endarteritis, 265
Enterectomy, 618
Enteritis, 608
Enterocele, 626
Entero-epiplocele, 626
Enterotomy, 618
Entropion, 490
Epiblastic tumours, 78
Epicanthus, 490
Epididymitis, 756
Epiglottis, wounds, of, 359
Epilepsy, trephining in, 352
Epileptiform neuralgia, 319
Epiphora, 490
Epiphyses, separation of, 168, 424, 426, 451, 456
Epiphysitis, 238
Epiplocele, 626
Epiplo-enterocele, 626
Epispadias, 686
Epistaxis, 548
Epithelioma, 82
— of bone, 230
— of lips, 515
— of nose, 548
— of œsophagus, 563
— of penis, 746
— of rectum, 670
— of scrotum, 747
— of tongue, 528
Epulis, 540
Erasion of joints, 253
Erysipelas, 136
— cellular, 141
— cellulo-cutaneous, 140
— cutaneous, 138
— phlegmonous, 140
— simple, 138
Esmarch's bandage in aneurism, 280
Estlander's operation, 381
Eustachian catheter, 471
Excision of breast, 788
— of joints, 253
— of larynx, 584
— of rectum, 672
— of testicle, 765
— of tongue, 530
Exomphalos, 653
Exophthalmic goître, 588
Exostosis, aural, 476
— cancellous, 225
— compact, 225
External carotid artery, ligature of, 294

External iliac artery, ligature of, 299
Extravasation of blood in brain, 342
— in tissues, 173
— of urine, 733
Extra-capsular fracture of femur, 450
— of humerus, 423
Extroversion of bladder, 686
Eye, diseases of, 485
— enucleation of, 509
— examination of, 485
Eyelids, diseases of, 489
— injuries of, 353

Face, injuries of, 353
Facial artery, ligature of, 295
— carbuncle, 515
Fæcal abscess, 633
— fistula, 643
Fæces, impaction of, 605, 611
Fallopian tube, diseases of, 771
False joint, 165
— passage, 721
Farcy, 151
Fasciæ, diseases of, 262
— contractions of, 262
Fat-embolism, 173
Fatty tumour, 65, 227
Fauces, diseases of, 538
Female genitals, diseases of, 766
— — injuries of, 401
— bladder, stone in, 706
Femoral aneurism, 291
— artery, ligature of, 300
— hernia, 650
Femur, dislocation of, 432
— fracture of, 448
— — of condyles of, 456
— — of neck of, 448
— — of shaft of, 452
— — of trochanter of, 452
— separation of epiphyses of, 451, 456
Fever, hectic, 24
— inflammatory, 10
— traumatic, simple, 129
— — septic, 134
— urethral, 722
Fibro-cellular tumours, 64
Fibroma, 64, 227
Fibula, fracture of, 456
Filaria sanguinis hominis, 748
Fingers, amputation of, 804
First intention, union by, 92
Fissure of anus, 658
Fistula, 25
— fæcal, 643
— in ano, 666
— recto-vaginal, 769
— salivary, 354
— urinary, 732
— vesico-intestinal, 691
— vesico-vaginal, 769
Flap amputation, 801
Flat-foot, 795, 800
Flexion in aneurism, 280
Foot, amputation of, 805
— injuries of, 445, 461, 465
Forceps, artery, 122
— aural, 470, 475
— torsion, 122
Forcipressure in hæmorrhage, 122
Forearm, amputation of, 803
— fractures of, 427
Foreign body in air-passages, 365
— in bladder, 399, 402
— in ear, 354
— in intestine, 605
— in larynx, 365
— in nose, 354
— in œsophagus, 364
— in pharynx, 364
— in rectum, 398
— in trachea, 366
— in urethra, 399, 402
— in vagina, 399
Fractures, 157
— causes of, 157
— compound, 168
— complications of, 172
— crepitus in, 159
— with dislocation, 172
— general pathology of, 157
— greenstick, 158, 418
— implicating a joint, 172
— malunited, 168
— reduction of, 162
— signs of, 157
— special (*see* Regions).
— treatment of, 162
— union of, 160
— ununited, 165
— varieties of, 157
— vicious union of, 168
Freund's operation, 776
Fungating caries, 210
Fungus of dura mater, 468
Furneaux Jordan's operation, 80

Furuncules of meatus, 474
Furunculus, 322
Fusiform aneurism, 271

GAG, Smith's, 534
Galactocele, 783
Gall-bladder, draining the, 623
— extirpation of, 623
— rupture of, 384
— stones, passage of, 605, 611
Ganglion, 259
Gangrene, 34
— causes of, 36
— diabetic, 41
— dry, 40
— from constriction, 173
— from ergot, 37
— from obliteration of artery, 37
— hospital, 142
— line of demarcation in, 35
— minute changes in, 35
— moist, 36
— Raynaud's, 41
— senile, 40
— signs of, 37
— spreading, 39
— symmetrical, 41
— traumatic, 39
— treatment of, 38
— of bowel in hernia, 638
— varieties of, 38
Gastro-enterostomy, 624
Gastrostomy, 566
Gastrotomy, 565
Genital organs, diseases of, 741
— — injuries of, 401
— — female, diseases of, 666
— — — injuries of, 399
Genu valgum, 790
— varum, 791
Gland disease, strumous, 314
Glanders, 150
Glandular tumour, 70
Glaucoma, 507
Gleet, 715
Glenoid cavity, fracture of, 422
Glioma, 74
Glossitis, 524
Glottis, œdema of, 569
— scalds of, 363
Gluteal aneurism, 289
Goître, 586
Goître, acute, 588
Gonorrhœa, 714
— complications of, 715
Gonorrhœal opthalmia, 491
Gordon's splints, 429
Greenstick fracture, 158, 418
Gumboil, 540
Gummata, 53
Gums, diseases of, 539
Gustatory nerve, division of, 529

HÆMATHROSIS, 174
Hæmatocele, 754
Hæmato-kolpos, 769
Hæmatoma, 105
Hæmato-metra, 769
— -salpinx, 769, 775
Hæmatoma auris, 473
— of labium, 398
— of scalp, 328
Hæmaturia, 708
Hæmatopnœa, 377
Hæmophilia, 59
Hæmothorax, 379
Hæmorrhage, 111
— arterial, 114
— capillary, 112, 126
— effects of, 112
— intermediary, 123
— internal, 112
— ligature in, 120
— natural arrest of, 115
— parenchymatous, 112
— primary, 115
— reactionary, 123
— recurrent, 123
— secondary, 124
— surgical, arrest of, 117
— transfusion in, 113
— treatment of, 113, 117
— venous, 126
Hæmorrhagic diathesis, 59
Hæmorrhoids, 660
Hamilton's test for dislocated shoulder, 407
Hand, amputation of, 803
— injuries of, 403
Hare-lip, 516
Hart's method of flexion, 280
Head, injuries of, 328
Healing by first intention, 92
— by granulation, 95
— by second intention, 95
— process of, 90

Healing by third intention, 96
  — under a scab, 96
Heart, injuries of, 378
Heat in hæmorrhage, 118
Hectic fever, 24
Hernia, 608, 625
  — causes of, 625
  — cerebri, 351
  — congenital, 645
  — diaphragmatic, 656
  — displaced, 641
  — femoral, 650
  — incarcerated, 642
  — infantile, 646
  — inflamed, 643
  — inguinal, 644
  — into funicular process, 646
  — internal, 647
  — irreducible, 629
  — labial, 645
  — Littre's, 632
  — lumbar, 656
  — of lung, 380
  — obstructed, 642
  — obturator, 655
  — perinæal, 656
  — phrenic, 656
  — pudendal, 656
  — radical cure of, 629
  — rarer forms of, 656
  — reducible, 627
  — reduction of, 627
  — sac of, 626
  — scrotal, 645
  — sciatic, 656
  — strangulated, 631
  — taxis in, 634
  — of testis, 759, 764
  — umbilical, 653
  — ventral, 657
Herniotomy, 635
Hey's amputation, 806
Hilton's method of opening an abscess, 22
Hip-joint, amputation at, 804
  — disease of, 243
  — dislocation of, 432
  — excision of, 256
Histrionic spasm, 319
Hodgkin's disease, 315
Holt's operation, 725
Hordeolum, 489
Horny growths, 69
Hospital gangrene, 142
Housemaid's knee, 264
Howse's method of suture in gastrostomy, 567
Humerus, dislocation of, 405
  — fracture of, 424
Hunter's operation, 218
Hyalitis, 506
Hydatid cyst, 88
Hydrencephalocele, 467
Hydrocele, 748
  — congenital, 751
  — of cord, 752
  — encysted, 751
  — infantile, 751
  — of the spermatic cord, 752
Hydro-nephrosis, 675
Hydrophobia, 151
Hydrops articuli, 233
Hydrosalpinx, 775
Hymen, imperforate, 769
Hyoid bone, dislocation of, 361
  — fracture of, 361
Hypermetropia, 570
Hypertrophy of bone, 218
  — of breast, 779
  — of muscle, 258
  — of prostate, 710
  — of tonsil, 538
Hyphæmia, 497
Hypoblastic tumours, 78
Hysterectomy, 776

Ichthyosis of tongue, 524
Iliac arteries, ligature of, 300
Impaction of fæces, 605
Imperforate anus, 657
  — hymen, 769
Impermeable stricture, 718, 723
Incarcerated hernia, 642
Incontinence of urine, 707
Infantile hernia, 646
  — hydrocele, 751
  — syphilis, 56
Infective processes in wounds, diseases due to, 132, 136
Inflammation, 1
  — acute, 1
  — causes of, 5
  — chronic, 16
  — fever in, 10
  — infective, 11
  — minute changes in, 2
  — process of, 1
  — septic, 11
  — signs and symptoms of, 9

Inflammation, terminations of, 2
— theory of, 5
— treatment of, 12
— varieties of, 11
Inflammatory delirium, 130
— fever, 10
Ingrowing toe-nail, 327
Inguinal aneurism, 287
— hernia, 644
Injuries, general pathology of, 89
Insect stings, 106
Intention, union by first, 92
— — second, 95
Intercostal artery, wounds of, 363
Internal carotid artery, ligature of, 294
Internal strangulation, 605, 612, 631
Internal urethrotomy, 725
Interrupted suture, 100
Intestinal obstruction, 605
Intestines, surgical diseases of, 605
— foreign bodies in, 605
— malformation of, 608
— rupture of, 384
— strangulation of, 605, 612, 631
— suture of, 388
— wounds of, 387
Intracapsular fracture of femur, 448
— — humerus, 422
Intracranial hæmorrhage, 342
— inflammation, 348
— suppuration, 335
Intraocular tension, 488
Intubation of larynx, 584
Intussusception, 606, 612
Iridectomy, 497
Irideræmia, 497
Iris, disease of, 497
— wounds of, 497
Iritis, 496
— serous, 499
— quiet, 496
— syphilitic, 53, 496
Irreducible hernia, 629
Irritable bladder, 689
— ulcer, 32
Ischiatic hernia, 656
Ischio-rectal abscess, 665
Ivory exostosis, 225

JAW, abscess of, 540, 541
— closure of, 541
— diseases of, 529
— dislocation of, 357
Jaw, excision of, 545, 547
— fracture of, 355
— necrosis of, 542
— subluxation of, 358
— tumours of, 543, 546
Jejunostomy, 624
Jobert's suture, 389
Joints, ankylosis of, 251
— Charcot's disease of, 248
— contusions of, 174
— diseases of, 231
— dislocations of, 176
— erasion of, 253
— excision of, 253
— loose bodies in, 249
— injuries of, 174
— neuralgia of, 253
— rheumatoid arthritis of, 245
— sprains of, 175
— strumous disease of, 243
— wounds of, 181

KELOTOMY, 635
Keratitis, 493
Kidney, aspiration of, 741
— abscess of, 675
— calculus of, 676
— cysts of, 678
— surgical diseases of, 673
— excision of, 680
— inflammation of, 673
— injuries of, 384
— operations on, 679
— rupture of, 384
— strumous, 678
— tuberculous, 678
— tumours of, 678
Knee, dislocations of, 444
— excision of, 257
Knock-knee, 790
Kyphosis, 593

LABIUM, abscess of, 767
— adhesion of, 766
— cysts of, 767
— elephantiasis of, 768
— epithelioma of, 767
— hæmatoma of, 398
— tumours of, 767
Laceration of brain, 344
Lachrymal abscess, 491
— apparatus, disease of, 490
Laparotomy, 616

Lardaceous disease, 25
Laryngitis, 568
— acute, 568
— chronic, 568
— membraneous, 570
— œdematous, 569
Laryngotomy, 581
Laryngo-tracheotomy, 583
Larynx, contusions of, 361
— disease of, 568
— extirpation of, 584
— foreign bodies in, 365
— fractures of, 362
— inflammation of, 568
— injuries of, 361
— intubation of, 584
— syphilis of, 572
— tubercle of, 572
— tumours of, 573
Lateral curvature of spine, 589
Lateral lithotomy, 700
Leg, amputation of, 805
— fracture of bones of, 459
Lembert's suture, 389, 396
Lens, diseases of, 500
Leucoplakia, 525
Ligature in aneurism, 280
— of arteries, 292
— dangers of, 283
— distal, 285
— double, 285
— gangrene after, 283
— in hæmorrhage, 120
— Hunterian, 281
— rules for, 292
— secondary hæmorrhage after, 124, 282
Lightning stroke, 111
Lingual artery, ligature of, 294
Lipoma, 65, 227
Lipoma nasi, 548
Lips, adenoma of, 515
— carbuncle of, 515
— chancre of, 516
— — diagnosis of, 516
— cysts of, 515
— diseases of, 514
— epithelioma of, 515
— fissures of, 514
— herpes of, 514
— hypertrophy of, 515
— malformations of, 516
— nævus of, 515
— tumours of, 515
— ulcers of, 515
Lisfranc's amputation, 806
Lister's abdominal tourniquet, 279
Liston's splint, 453
Lithic acid deposits, 681
Litholapaxy, 697
Lithotomy, 700
— lateral, 700
— median, 705
— supra-pubic, 706
Lithotrity, 697
Littre's hernia, 632
— operation, 621
Liver, aspiration of, 622
— incision of, 622
— rupture of, 384
Locked jaw, 155
Loose bodies in joints, 249
— — in bursæ, 263
— — in ganglia, 260
Lordosis, 594
Loreta's operation, 624
Lower extremity, injuries of, 432
Lumbar abscess, 597
— colotomy, 619
Luer's forceps, 120
Lung, contusion of, 377
— hernia of, 380
— prolapse of, 380
— wounds of, 377
Lupus erythematosus, 326
— vulgaris, 325
Lymph-scrotum, 748
Lymphadenitis, 313
Lymphadenoma, 315
Lymphangiectasis, 313
Lymphangioma, 69
Lymphangitis, 312, 717
Lymphatic fistula, 313
— varix, 313
Lymphatics, diseases of, 312
Lymphorrhœa, 313
Lympho-sarcoma, 74, 316

MACROGLOSSIA, 524
Malignant pustule, 143
Malgaigne's hooks, 458
Malunited fracture, 168
Mammary gland (*see* BREAST).
Manipulation in aneurism, 286
— — dislocation, 178
— — — of hip, 439
— — — of shoulder, 409
Manning's splint, 458

- Mastitis, 778
- Mastoid disease, 480
- Meatus, diseases of, 474
- Meckel's ganglion, excision of, 319
- Median lithotomy, 705
- Mediastinal abscess, 376
- Medio-tarsal amputation, 806
- Medullary cancer, 81
- Meibomian cyst, 489
- Melanotic sarcoma, 74
- Membraneous laryngitis, 570
- Membrani tympani, appearance of, 470
  - — artificial, 478
  - — perforation of, 478
- Menière's disease, 483
- Meningeal artery, rupture of, 342
- Meningitis, 348
  - — in ear disease, 481
- Meningocele, 467
  - — spinal, 602
- Meningo-encephalitis, 348
- Meningo-myelocele, 602
- Mercurial teeth, 59
- Mesoblastic tumours, 64
- Metastatic abscess, 147
- Micrococci, 8
- Micro-organisms, 7
- Milk cysts, 783
- Mixed calculus, 686
  - — sarcoma, 78
- Mollities ossium, 222
- Molluscum fibrosum, 65
- Morbus coxæ (*see* Hip Disease).
- Mortification, 34
- Mouth, diseases of, 514
- Mucocele, 491
- Mucous cysts, 86
  - — membranes, syphilitic affections of, 52
  - — tubercles, 52
  - — tumours (*see* Myxoma).
- Mulberry calculus, 685
- Mumps, 585
- Muscles, atrophy of, 258
  - — contusions of, 183
  - — degenerations of, 258
  - — diseases of, 258
  - — gummata in, 258
  - — hypertrophy of, 258
  - — inflammation of, 258
  - — injuries of, 183
  - — ossification of, 259
  - — rupture of, 184, 402, 432
  - — sprains of, 402
- Muscles, tumours of, 259
  - — wounds of, 184
- Muscle-tumours, 69
- Muscular tie, 319
- Myeloid sarcoma, 77
- Myoma, 69
- Mydriasis, 497
- Myopia, 511
- Myxoma, 67

- Nævus, 310
  - — capillary, 310
  - — venous, 310
- Nares, plugging the, 549
- Nails, diseases of, 327
  - — ingrowing, 327
- Nasal bones, fracture of, 355
  - — catarrh, 551
  - — cavity, examination of, 550
  - — douche, 554
  - — polypi, 556
  - — specula, 551
  - — spray, 554
  - — tumours, 560
- Naso-pharyngeal tumours, 560, 562
- Natiform skull, 58
- Neck, injuries of, 359
  - — wounds of, 359
- Necrosis, 211
  - — in ear disease, 480
  - — of jaw, 542
  - — of nasal bones, 559
  - — phosphorus, 542
  - — quiet, 215
  - — of skull, 467
- Needles, acupressure, 123
  - — palate, 535
  - — surgical, 99
- Nelaton's line, 435
  - — splint, 430
  - — operation, 557, 618
- Nephrectomy, 680
- Nephritis, 673
  - — simple interstitial, 673
  - — suppurative or septic, 674
- Nephro-lithotomy, 679
- Nephrorraphy, 681
- Nephrotomy, 679
  - — grafting, 198
- Nerve-stretching, 318
  - — suturing, 197
- Nerves, compression of, 198
  - — contusion of, 199

Nerves, degeneration of, 195
 — diseases of, 316
 — foreign bodies in, 199
 — injuries of, 195
 — rupture of, 198
 — transplantation of, 198
 — tumours of, 319
 — wounds of, 195
Nervous traumatic delirium, 130
Neuralgia, 317
 — of breast, 776
 — epileptiform, 317
 — of joints, 253
 — of testicle, 765
Neurectomy, 318
Neuritis, 316
 — retro-bulbar, 504
Neuroma, 69
Neurotomy, 318
Nodes, 203
Noma, 768
Nose, diseases of, 548
 — foreign bodies in, 354
 — fracture of bones of, 355
 — polypus of, 556
Nystagmus, 514

Oblique inguinal hernia, 644
Obstructed hernia, 642
Obturator hernia, 655
Occipito-atloid disease, 600
Ocular paralysis, 512
Œdema glottidis, 569
 — solid, 304
Œsophagotomy, 368
Œsophagus, cancer of, 563
 — diseases of, 563
 — foreign bodies in, 364
 — injuries of, 363
 — rupture of, 363
 — stricture of, 563
 — wounds of, 363
Ogston's operation, 791
Olecranon, fracture of, 430
Omphalocele, 653
Onychia, 322
Oöphorectomy, 775
Operations, treatment of patient before and after, 101
Ophthalmia, 491
 — catarrhal, 492
 — gonorrheal, 491
 — granular, 492
 — membraneous, 492
Ophthalmia, muco-purulent, 492
 — neonatorum, 491
 — phlyctenular, 493
Ophthalmoplegia externa, 514
Opisthotonos, 155
Optic nerve, diseases of, 503
 — neuritis, 503
Orbit, diseases of, 508
Orbital aneurism, 288
Orchitis, simple, 756, 758
 — strumous, 758
 — syphilitic, 760
 — tubercular, 758
Orthopædic surgery, 709
Os calcis, fracture of, 465
Osseous tumours, 67
Osteitis, 206
Osteo-arthritis, 245
Osteo-malacia, 222
Osteo-myelitis, 204
Osteo-porosis, 58
Osteo-sarcoma, 228
Osteo-sclerosis, 207
Osteoma, 67, 225
Osteophytes, 247
Osteoplastic osteitis, 207
Osteotomy, 791
Otomycosis, 475
Ovarian dropsy, 771
 — tumours, 771
Ovaries, diseases of, 771
Ovariotomy, 773
Oxalate of lime calculi, 685
 — deposits, 681
Ozæna, 558

Painful subcutaneous tumours, 64
Palate, cleft, 533
 — diseases of, 533
 — operation for closure of, 534
Palm, needle in the, 403
 — wounds of, 403
Palmar arch, wounds of, 403
 — fascia, contraction of, 262
Pannus, 493
Panophthalmitis, 498
Papilitis, 504
Papilloma, 69
Papillo-retinitis, 504
Paracentesis abdominis, 392
 — of pericardium, 382
 — of pleura, 381

Paralysis of third nerve, 513
Paraphimosis, 741
Paronychia tendinosa, 261
Parosteal sarcoma, 229
Parotid gland, diseases of, 585
— tumours of, 585
Parotitis, 585
Parrot's nodes, 58
Patella, bursa over, 254
— dislocation of, 443
— fracture of, 456
Pelvis, fracture of, 392
— injuries of, 392
Penetrating wounds of abdomen, 385
— — chest, 374
Penis, amputation of, 746
— diseases of, 741
— epithelioma of, 746
— injuries of, 401
— ligature of, 401
— venereal sores on, 49, 744
Perforating ulcer of foot, 320
Pericardium, incision of, 382
— injuries of, 378
— tapping, 382
Perinæal abscess, 732
— fistula, 733
— hernia, 656
— section, 729
Perinæum, rupture of, 399
Perinephritic abscess, 675
Periosteal abscess, 201
— node, 203
— sarcoma, 229
Periostitis, 201
— acute, 201
— chronic, 203
— diffuse, 201
— infective, 201
— simple, 201
Periprostatic abscess, 710
Peritoneum, inflammation of, 391
— injuries of, 383
— laceration of, 383
Peritonitis, 608
— traumatic, 391
Peritomy, 493
Phagedæna, 142
Phagedænic chancre, 746
— ulcer, 31
Phalanges, dislocation of, 416
— fracture of, 431, 465
Pharyngeal abscess, 562
Pharyngitis, 561
Pharyngotomy, 368
Pharynx, burns of, 363
— diseases of, 561
— foreign bodies in, 364
— injuries of, 362
— stenosis of, 562
— tumours of, 562
Phimosis, 742
Phlebitis, 305
— adhesive, 305
— suppurative, 306
Phleboliths, 304
Phlegmasia dolens, 304
Phlegmonous erysipelas, 138
Phosphatic calculi, 686
— deposits, 682, 686
Phosphorus-necrosis, 542
Phrenic hernia, 656
Piles, 660
Pinguecula, 493
Pirogoff's amputation, 805
Pleura, incision of, 381
— injury of, 377
— tapping, 381
Pleurosthotonos, 152
Pneumothorax, 379
Pneumotomy, 382
Poisoned wounds, 104
Politzer's bag, 471
Polycoria, 497
Polypus, aural, 479
— of bladder, 691
— of nose, 556
— of rectum, 668
— snare, 479
Popliteal aneurism, 291
Port-wine marks, 310
Post-mortem wounds, 104
Post-pharyngeal abscess, 562
Pott's disease of spine, 594
— fracture, 461
— puffy tumour, 330
Prepuce, operations on, 743
— dilatation of, 744
— slitting of, 743
Presbyopia, 511
Pressure in hæmorrhage, 119
— in aneurism, 227
Priapism, 371
Primary union of wounds, 92
Prolapse of rectum, 659
Proptosis, 509
Prostate, abscess of, 710
— calculi of, 713
— diseases of, 709

Prostate, enlargement of, 710
 — inflammation of, 709
 — malignant disease of, 713
 — retention of urine in enlarged, 739
 — tubercle of, 713
Prostatitis, 709
Pruritus ani, 658
Psammoma, 74
Pseudarthrosis, 165
Pseudo-glioma, 499
Psoas abscess, 596
Pterygium, 493
Ptomaines, 7
Ptosis, 490
Pubes, dislocation on, 437
Pudenda, injuries of 398
Pulleys in dislocation, 179, 410, 440
Pulpy degeneration of joints, 239
Pulsatile tumours of bone, 229
Punctured fracture of skull, 331, 332
 — wounds, 104
Puncture of bladder, 740
Purulent catarrh of ear, 479
Pus, characters of, 20
 — formation of, 18
 — varieties of, 20
Pustule, malignant, 143
Putrefaction as a cause of inflammation, 6
 — prevention of, in wounds, 100
Pyæmia, 145
Pyelitis, 673
Pyelo-nephritis, 673
Pylorectomy, 624
Pyogenic zone, 18
Pyo-nephrosis, 675
Pyo-salpinx, 775

Quiet iritis, 496
 — necrosis, 215
Quinsy, 537

Radial artery, ligature of, 298
Radical cure of hernia, 629
Radius, dislocation of, 414, 416
 — fracture of, 427
Railway spine, 374
Ranula, 522
Rarefying osteitis, 208
Raynaud's disease, 41
Reaction after shock, 128
 — of degeneration, 196
Rectocele, 770
Recto-vaginal fistula, 769
Rectum, cancer of, 670
 — diseases of, 657
 — excision of, 672
 — fissure of, 658
 — foreign bodies in, 398
 — injuries of, 398
 — malformations of, 657
 — malignant stricture of, 670
 — polypus of, 668
 — prolapse of, 659
 — stricture of, 669
 — syphilis of, 669
 — ulcer of, 658
 — villous tumour of, 669
Reduction "en masse," 644
Reef-knot, 121
Renal calculus, 676
 — colic, 677
 — hæmaturia, 708
Repair, process of, in fractures, 160
 — in wounds, 90
Resection of joints, 254
Residual abscess, 23
Retained testis, 765
Retention of urine, 736
Retina, detachment of, 506
 — diseases of, 503
Retinitis, 505
Retinoscopy, 487
Retro-bulbar neuritis, 504
Retro-pharyngeal abscess, 562
Rhagades, 51
Rheumatoid arthritis, 245
Rhinitis, 551
Rhinoliths, 555
Rhinoscopy, 550
Ribs, fracture of, 374
Rickets, 219
Rider's bone, 259
Risus sardonicus, 155
Rodent ulcer, 520
Rouge's operation, 557
Roughton's splint, 464
Rupia, 52
Rupture of abdominal viscera, 348
 — of aneurism, 278, 275
 — of artery, 185
 — — in fracture, 174
 — of bladder, 394

Rupture of perinæum, 399
— of trachea, 361
— of urethra, 396

SACCULATED bladder, 689
Salivary calculus, 522
— fistula, 354
Salpingitis, 775
Sapræmia, 135
Sarcoma, 72
— alveolar, 74
— of bone, 227
— of breast, 781
— giant-celled, 77
— glio-, 74
— lympho-, 74
— melanotic, 74
— mixed-celled, 78
— myeloid, 77
— osteo-, 228
— round-celled, 73
— spindle-celled, 75
Sayre's jacket, 599
Scab, healing under, 92, 96
Scalds, 108
Scalp, abscess of, 466
— cellulitis of, 466
— contusion of, 328
— diseases of, 466
— erysipelas of, 466
— hæmatoma of, 328
— injuries of, 328
— sebaceous cysts of, 466
— tumours of, 468
— wounds of, 329
Scapula, fractures of, 421
Schrapnell's membrane, 470
Schroeder's operation, 776
Sciatic notch, dislocation into, 435
Scirrhous carcinoma, 80
— of breast, 784
Sclero-corneal wounds, 496
Sclerosis, 207
Sclerotic, disease of, 493
— wounds of, 496
Scoliosis, 589
Scorbutic ulcers, 34
Scotoma, 504
Scrofula (*see* STRUMA).
Scrotum, diseases of, 747
— epithelioma of, 747
— œdema of, 747
— elephantiasis of, 748
— erysipelas of, 747
Scrotum, injuries of, 401
Sebaceous cysts, 86
— deep, of neck, 523
— on scalp, 466
Second intention, healing by, 95
Senile gangrene, 40
Separation of epiphyses, 168, 424, 426, 451, 456
Sepsin, 7
Septic processes in wounds, disease due to, 132
— traumatic fever, 134
— infection, 144
— intoxication, 135
Septicæmia, 144
Septum nasi, deflection of, 559
— diseases of, 558
— injuries of, 355
— malformation of, 559
Sequestrotomy, 216
Sero-cystic disease of breast, 782
Serous cysts, 87, 783
Serpents, stings of, 106
Shock, 127
Shoulder, amputation at, 802
— compound dislocation of, 412
— dislocation of, 405
— excision of, 254
Sinus, 25
Skin, surgical diseases of, 320
— grafting, 30
Skull, caries of, 467
— contusions of, 330
— diseases of, 466
— fracture of, 331
— — of base of, 336
— injuries of, 330
— necrosis of, 467
— trephining the, 351
— tumours of, 468, 469
Sloughing phagedæna, 32, 142
— ulcer, 31
Smith's gag, 534
— needles, 534
Snake bites, 106
Snellen's test-types, 488
Soft sore, 744
Sounding for stone, 695
Spanton's operation, 629
Spasm of the œsophagus, 563
— of the urethra, 738
Spasmodic stricture, 738
Specula, aural, 470
Spermatic cord, diseases of, 747

Spermatic cord, hydrocele of, 652
— — tumours of, 754
— — varicocele of, 752
Sphacelus, 35
Spica bandage, 628
Spina bifida, 601
Spinal cord, injuries of, 369, 370
Spine, caries of, 594
— concussion of, 374
— angular curvature of, 597
— lateral curvature of, 589
— diseases of, 589
— dislocation of, 369
— fracture- dislocation of, 369
— fractures of, 369
— injuries of, 368
— Pott's disease of, 594
— railway, 374
— sprains of, 368
— wounds of, 369
Spleen, extirpation of, 624
— rupture of, 385
Splenectomy, 624
Sponge-grafting, 30
Spontaneous aneurism, 268
Sprains, 175, 402, 432
Squint, 512
Staphyloraphy, 534
Stasis in inflammation, 3
Sterno-mastoid muscle, contraction of, 789
— division of, 789
Sternum, fracture of, 376
Stiff-joint, 251
Stings of insects, 106
— of serpents, 106
Stomach, rupture of, 385
— dilatation of the cardiac and pyloric ends of, 624
— opening the, 565
Stomatitis, 520
Stone (*see* Calculus).
Strabismus, 512
Strangulated hernia, 631
Strangulation, internal, 605, 612
Stricture of œsophagus, 563
— of intestines, 608
— of pharynx, 562
— of rectum, 669
— of urethra, 717
Stromeyer's cushion, 427
Struma, 45
— in bone, 209, 219
— causes of, 46
— symptoms of, 46
Strumous glands, 314
— testicle, 758
— ulcer, 33
Stye, 489
Styptics in hæmorrhage, 119
Sub-astragaloid dislocation, 447
Sub-clavian aneurism, 287
— artery, ligature of, 295
Sub-clavicular dislocation, 408
Sub-coracoid dislocation, 407
Subcutaneous wounds, 107
Sub-glenoid dislocation, 408
Sub-hyoid pharyngotomy, 584
Sub-lingual cysts, 523
Sub-spinous dislocation, 408
Superior thyroid artery, ligature of, 295
Suppression of urine, 679
Suppuration, 17
— diffuse, 24
— effects of, 24
— in bone, 216
Suture-catcher, 535
Sutures, 99
— continuous, 100
— interrupted, 100
— Jobert's, 389
— Lembert's, 389
Symblepharon, 489
Syme's amputation, 805
— operation for aneurism, 289
— — for stricture, 728
Symonds' tubes, 566
Sympathetic inflammation of eye, 499
— irritation, 499
Syndesmotomy, 798
Synechia, 496
Synovitis, acute, 231
— chronic, 233
— strumous, 239
Syphilides, 51
Syphilis, 47
— bone disease in, 58, 219
— congenital, 56
— primary, 49
— secondary, 51
— tertiary, 53
— in tongue, 529
— treatment of, 54
Syphilitic iritis, 53
— gummata, 53
— teeth, 59
— ulcers, 33
Syringo-myelocele, 603

TALIPES, 791
— calcaneus, 794, 800
— cavus, 793
— equinus, 793, 799
— valgus, 795, 800
— varus, 793, 799
Tapping abdomen, 623
— hydrocele, 750
— pericardium, 382
— pleura, 381
Tarsectomy, 798
Tarsotomy, 798
Tarsus, fracture of, 465
Taxis, 634
Teale's amputation, 802
Teeth, mercurial, 59
— syphilitic, 59
Temporal artery, ligature of, 295
Tendons, injuries of, 183
— diseases of, 259
— dislocation of, 185
— division of, 796
— evulsion of, 185
— rupture of, 185
— wounds of, 184
Teno-synovitis, 259
Tenotomy, 796
— of rectus, 513
— of tibials, 797
— of tendo Achillis, 797
Testis, atrophy of, 765
— diseases of, 747
— enchondroma of, 762
— encysted hydrocele of, 748
— excision of, 765
— inflammation of, 756, 758
— injuries of, 401
— malignant disease of, 763
— neuralgia of, 765
— retained, 765
— syphilis of, 760
— tubercle of, 758
Tetanus, 154
Thigh, amputation of, 805
Thomas' splint for knee, 235
— — for hip, 234
— — for spinal caries, 599
Thoracoplasty, 381
Thorax, injuries of (*see* CHEST)
Thrombosis, 303
Thrush, 521
Thumb, amputation of, 803
— dislocation of, 416
Thyroid body, diseases of, 586
Thyroid foramen, dislocation into, 437
Thyrotomy, 584
Tibia, fracture of, 459
Tibial arteries, ligature of, 302
Tic, convulsive, 317
Tinea tarsi, 489
Tinnitis aurium, 484
Toe-nail, ingrowing, 327
Toes, amputation of, 807
Tongue, diseases of, 523
— abscess of, 524
— epithelioma of, 528
— excision of, 530
— gumma of, 529
— hypertrophy of, 524
— inflammation of, 524
— non-differentiation of, 523
— syphilis of, 527, 529
— tumours of, 529
— ulcers of, 525
Tongue-tie, 523
Tonsil, diseases of, 537
— excision of, 538
— hypertrophy of, 538
Tonsillitis, 537
Torsion of arteries, 121
Torticollis, 789
Toxic amblyopia, 504
Toynbee's drum, 478
Trachea, foreign bodies in, 366
— rupture of, 361
— wounds of, 359
Tracheotomy, 575, 576
Trachoma, 492
Transfusion of blood, 113
Traumatic aneurism, 191
— delirium, 130
— fever, 129, 134
— gangrene, 39
Trephining bone, 218
— skull, 351
— spine, 374
Trichiasis, 490
Trusses, 628
Tubercle, 42
— causes of, 44
— secondary changes in, 44
— structure of, 42
— in bone, 219
— bacillus, 44
Tubercles, mucous, 52
Tuberculosis, 42
Tumours, 60
— of bladder, 691

Tumours of bone, 224
- of brain, 469
- causes of, 62
- classification of, 63
- development of, 61
- dissemination of, 63
- innocent, 62
- of kidneys, 678
- malignant, 62
- of nerves, 319
- secondary changes in, 63
- of tongue, 529
- varieties of, 64

ULCERATION, 26
- causes of, 28
- minute changes in, 27
- treatment of, 28

Ulcers, 29
- anal, 658
- callous, 32
- chronic, 32
- eczematous, 32
- œdematous, 30
- exuberant, 30
- fungous, 30
- gouty, 34
- healing, 29
- inflamed, 30
- inflammatory, 30
- irritable, 33
- perforating, 320
- phagedænic, 31
- rodent, 520
- scorbutic, 34
- simple, 29
- sloughing, 31
- strumous, 33
- syphilitic, 33
- tuberculous, 33
- varieties of, 29
- varicose, 32, 308

Ulna, dislocation of, 414
- fracture of, 427, 430

Ulnar artery, ligature of, 298
Umbilical hernia, 653
Ungual exostosis, 225
Union of wounds, 90
Unreduced dislocations, 178, 180
Ununited fracture, 165
Upper extremity, fractures of, 418
- injuries of, 402

Uranoplasty, 536
Urates, 681
Ureter, dilatation of, 719
Urethra, calculus in, 735
- dilatation of, 724
- diseases of, 714
- foreign body in, 399, 402
- inflammation of, 714
- injury of, 396
- rupture of, 396
- stricture of, 717
- tumours of, 736

Urethritis, 714
Urethrotomy, external, 728
- internal, 725

Uric acid calculi, 685
- deposits, 681

Urinary abscess, 732
- calculus, 681, 684
- deposits, 681
- fistula, 732
- organs, diseases of, 673

Urine, extravasation of, 733
- incontinence of, 707
- retention of, 736
- suppression of, 679

Uterus, extirpation of, 776
Uveal tract, diseases of, 496
Uveitis, 498
Uvula, elongation of, 533
Uvulitis, 533

VAGINA, diseases of, 768
- fistula of, 769
- foreign bodies in, 399
- injuries of, 399
- malformations of, 770
- tumours of, 768
- wounds of, 399

Vaginal lithotomy, 707
Vaginitis, 768
Varicocele, 752
Varicose aneurism, 192
- ulcer, 32, 308
- veins, 307

Varix, aneurismal, 192
Vascular tumour of urethra, 736
Vault of skull, fracture of, 331
Veins, diseases of, 303
- entrance of air in, 194
- injuries of, 193
- rupture of, 193
- varicose, 307
- wounds of, 194

Venereal disease, 47, 741
- sore, 744

Ventral hernia, 657
Verruca, 320
Vesico-intestinal fistula, 691
  — -vaginal fistula, 769
Vicious union, 168
Villous growths, 69
  — of bladder, 691
  — of larynx, 573
  — of rectum, 669
Vitreous, diseases of, 506
Volvulus, 605, 612, 614
Vulva, diseases of, 766
  — injuries of, 398
  — pruritus of, 767
Vulvitis, 766

Wallerian degeneration, 195
Wardrop's operation for aneurism, 281, 285
Warren's operation, 629
Warts, 320
  — venereal, 320
Warty tumours, 69
Wax in ear, 475
Wens, 65
Wire-twister, 535
Wheelhouse's operation, 730
Whitehead's operation for removal of tongue, 531
Whitlow, 261
Wood's operation for hernia, 629
Wound-diphtheria, 143
Wounds, closure of, 99
  — cleansing of, 97
  — constitutional treatment of, 101
  — contused, 103
  — dissection, 104
  — drainage of, 97
  — healing of, 91
  — incised, 103
  — lacerated, 103
  — open, 90
  — poisoned, 104
  — prevention of putrefaction in, 100
  — punctured, 104
  — repair of, 90
  — subcutaneous, 107
  — treatment of, 96
  — varieties of, 103
Wrist, amputation of, 803
  — dislocation of, 416
  — excision of, 255
Wryneck, 789

Yearsley's drum, 478

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